

# Dynamic Multi-Modality Fused Imaging, Analysis, Computer Aided Diagnosis System

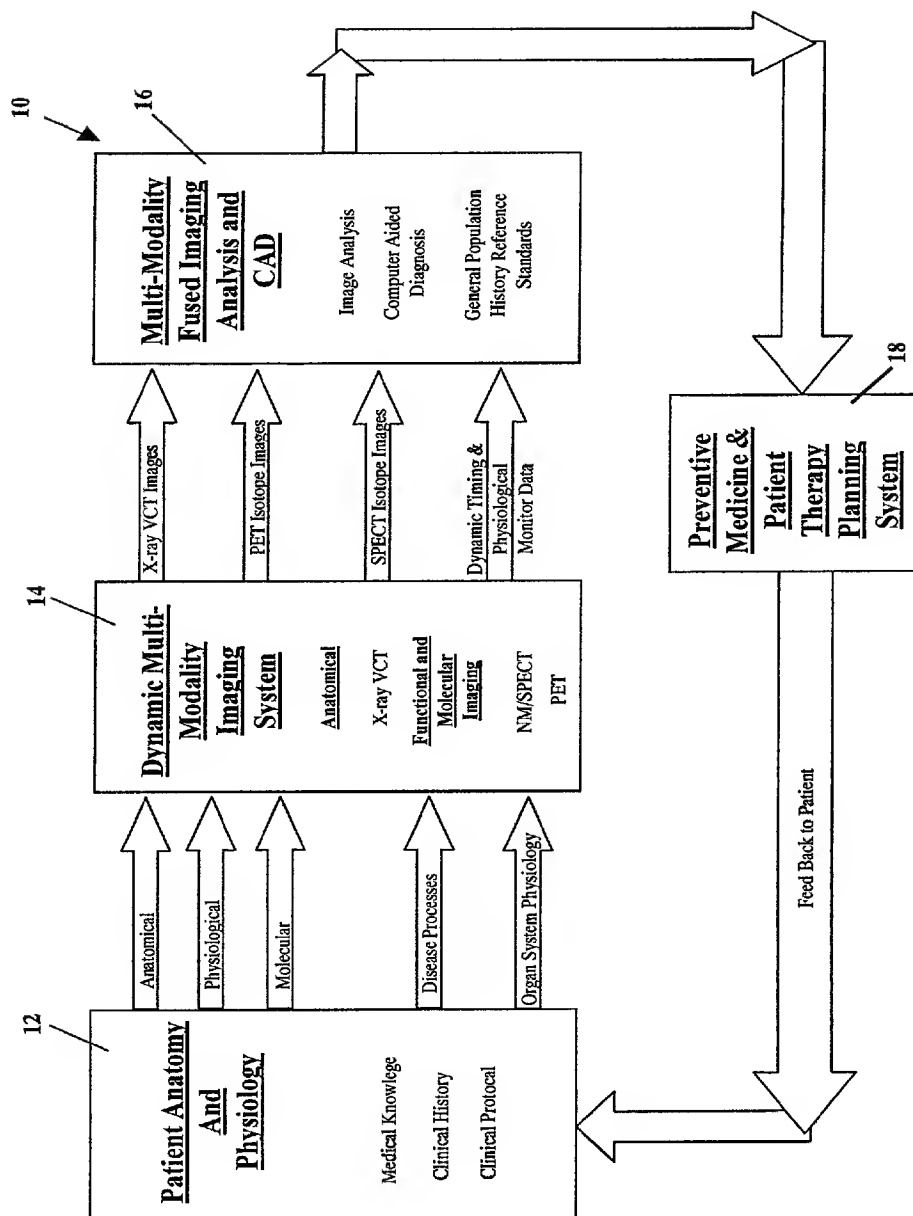


Figure 1

Multi-Modality Imaging System with Common Focused 2D Curved Detector

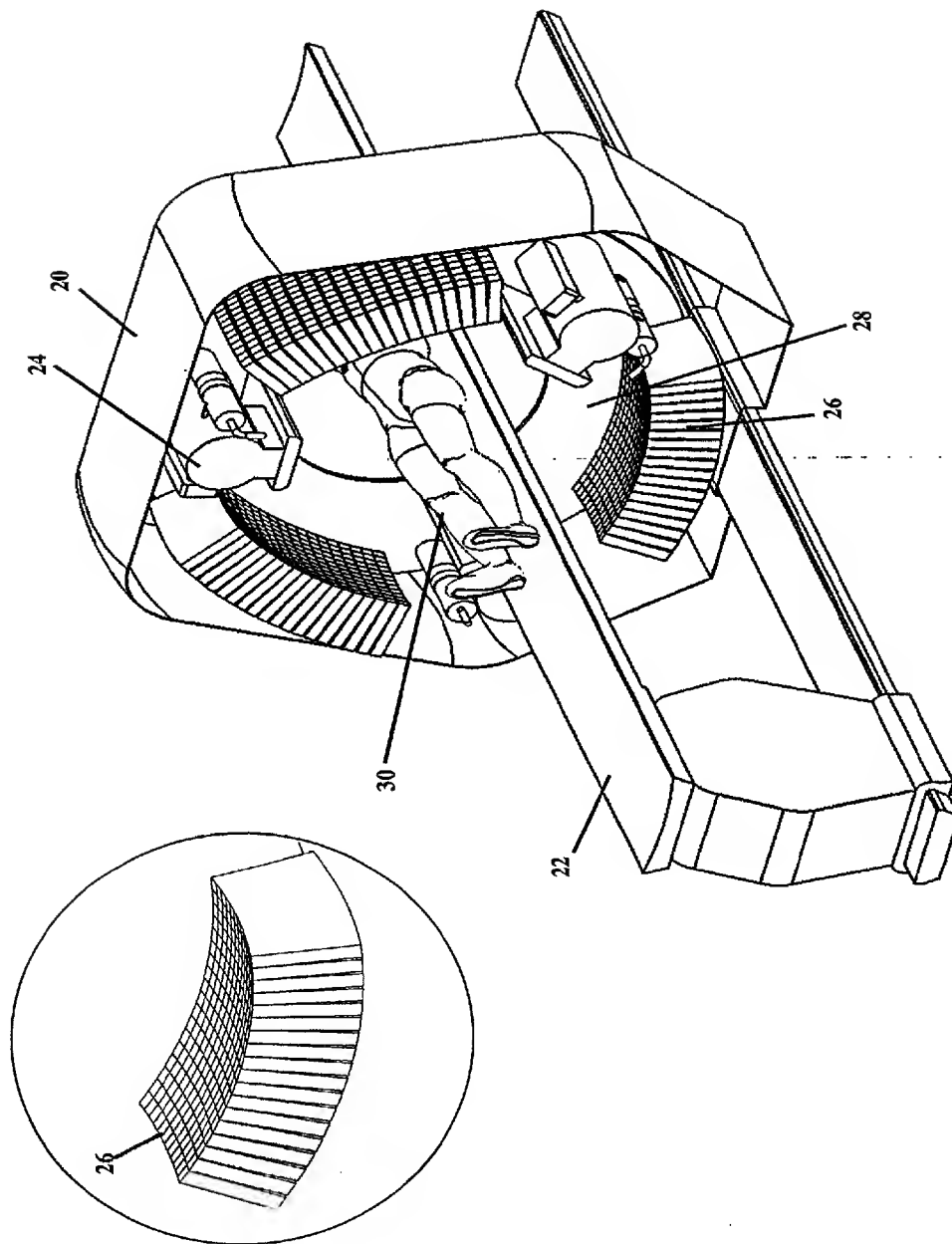


Figure 2

[illegible]

X-ray & Focused 2D Curved Detector Arrangement

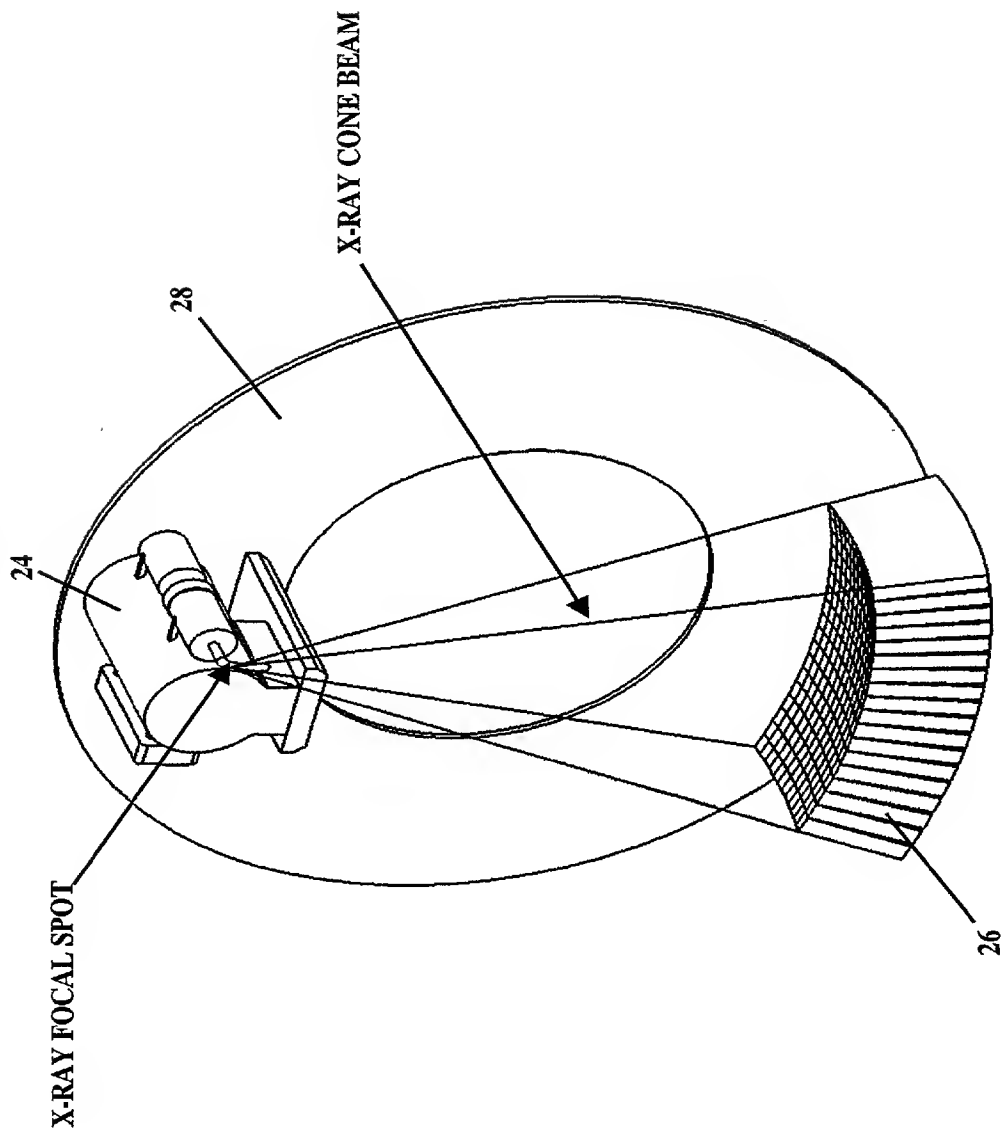


Figure 4

# Cone Beam Source Collimation & Cone Beam Shaped Filter

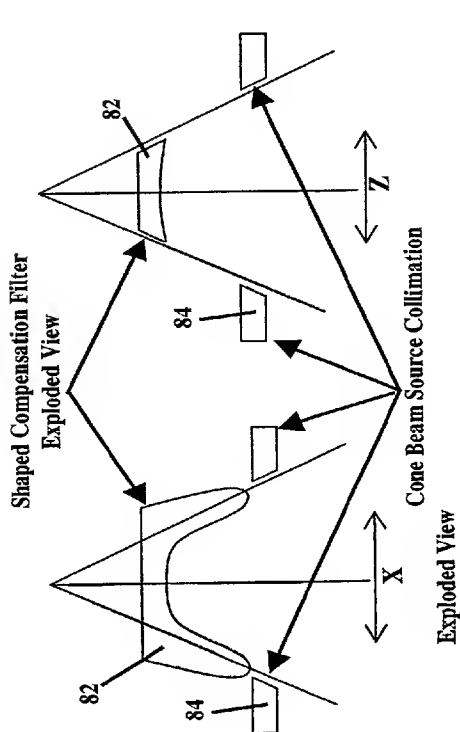
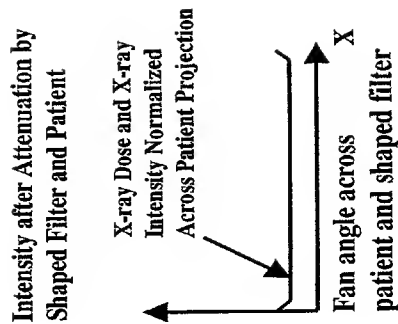
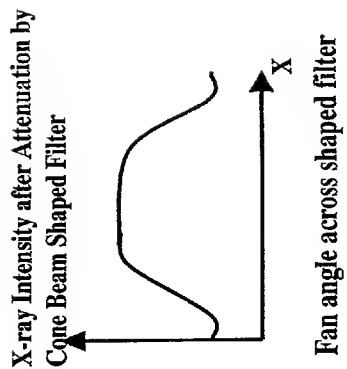
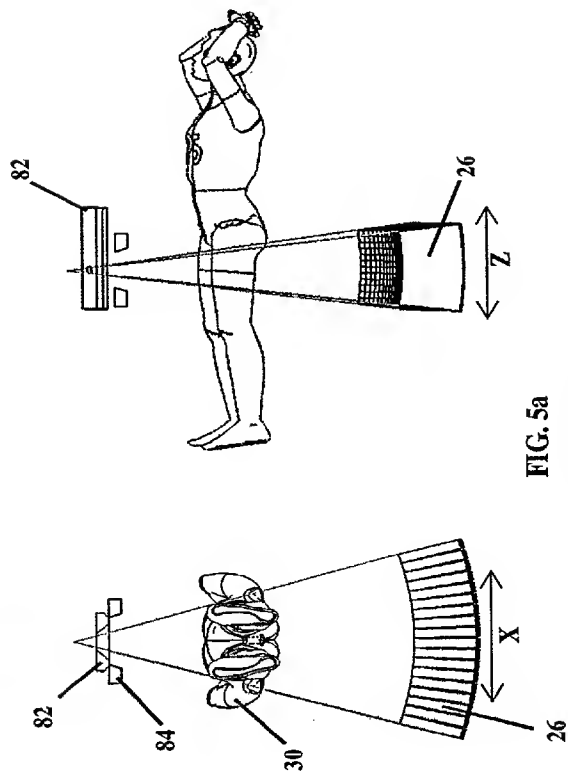


Figure 5

# X-ray Cone Beam Focal Spot - Curved Detector Optics

Curved Detector to reduce spatial resolution loss and Best Conversion efficiency of X-ray

Focal spot from V-groove Type Anode has similar spot size appearance

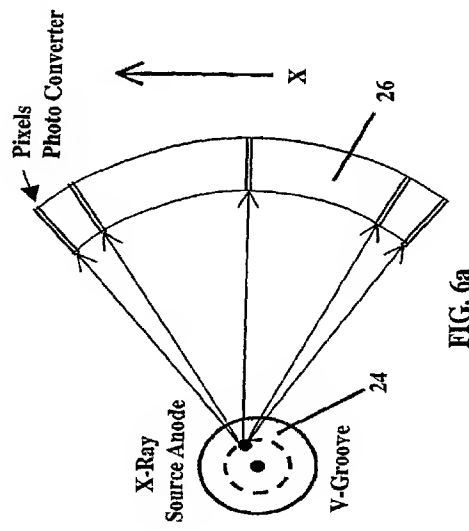
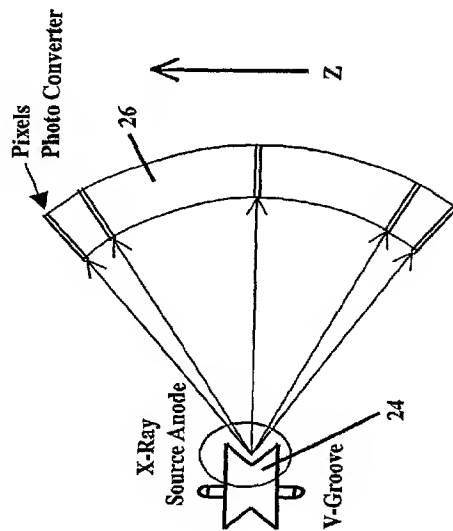


FIG. 6a

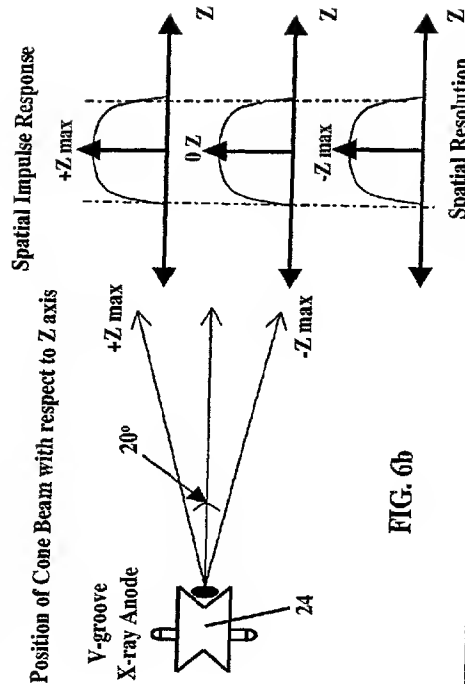


FIG. 6b

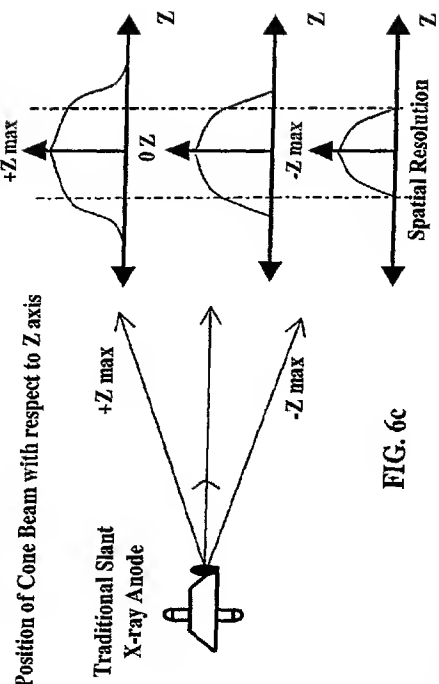


FIG. 6c

Figure 6

# 2 Dimensional Focal Spot Dithering for Improved Cone Beam

## Spatial Resolution

### X-ray Focal Spot Geometric Dithering For Doubling the Spatial Sampling Rate

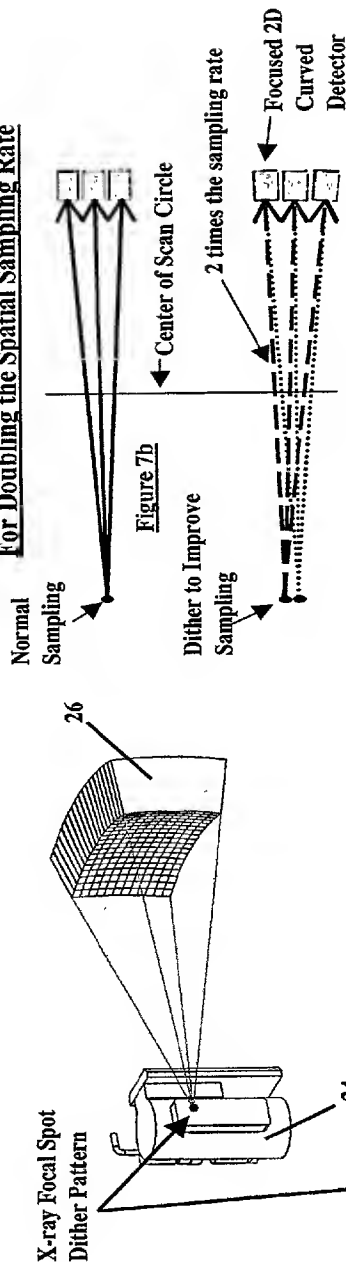


Figure 7a

### 2D X-ray Focal Spot Dither Pattern for 3D Cone Beam VCT

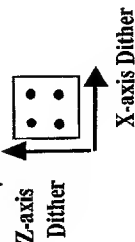


Figure 7d

Figure 7c

### Spatial Resolution comparison between Single Sampling and 2X Dither Sampling

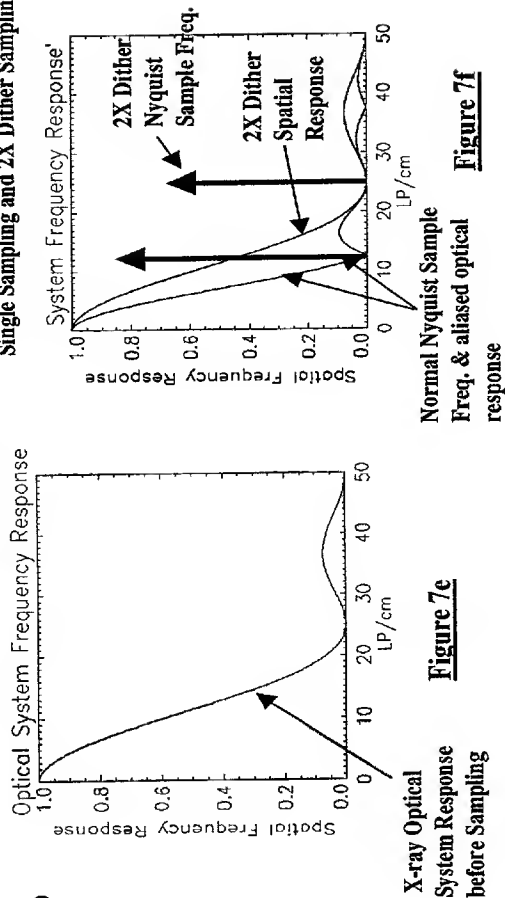


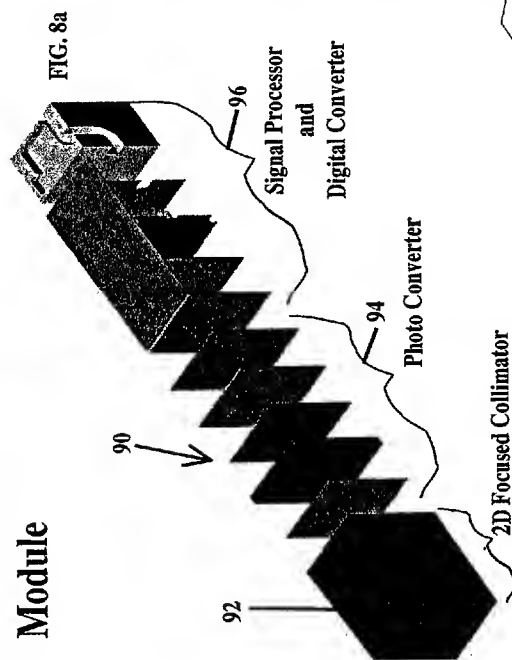
Figure 7e

Figure 7f

Figure 7

## Focused 2D Curved Detector Module

### Focused Curved Detector Module



### View Showing Focused 2D Anti-scatter Collimation with 2D Focused Pixels

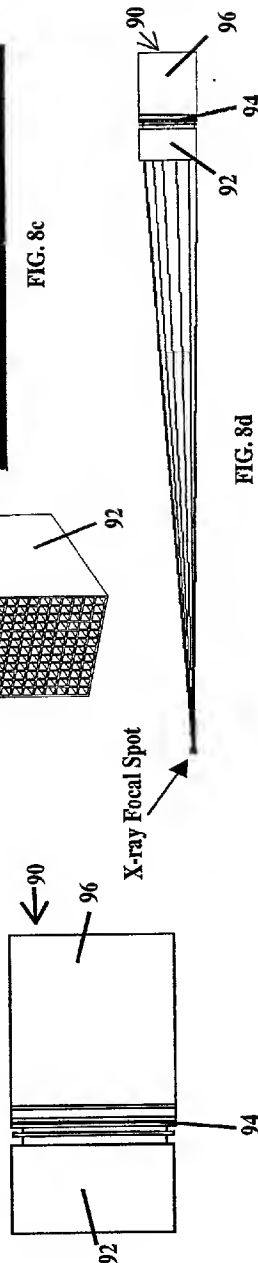
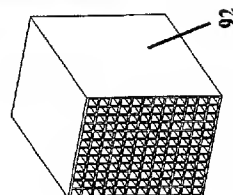
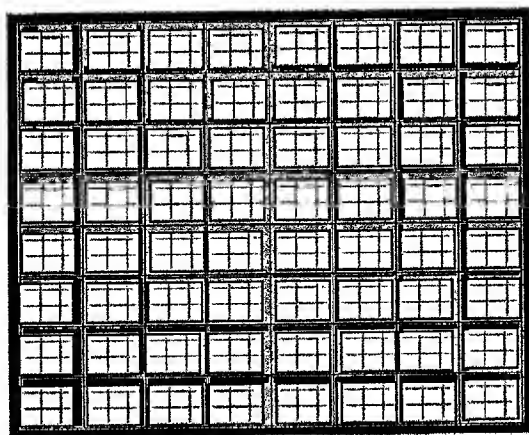


FIG. 8b

Figure 8



# Focused 2D Area Detector with Adaptive Shaped X-Ray Optical Response

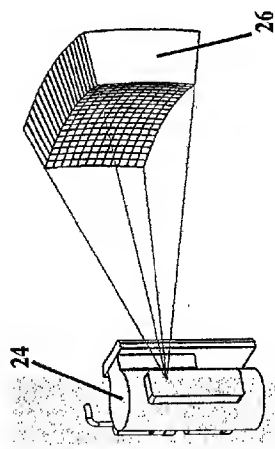
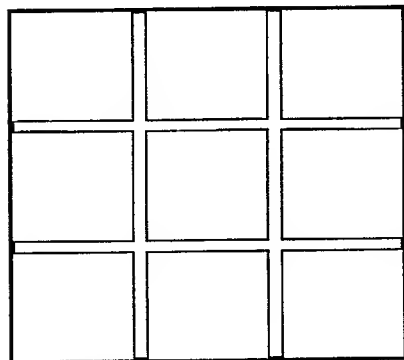
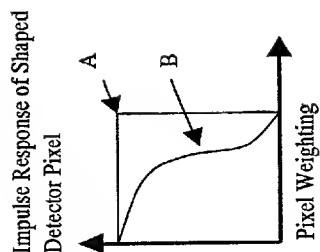


FIG. 9a

Impulse Response Shaping from Rectangular to Variable gaussian Roll-off Function. Shaping may be Fixed or Controlled



Detector Pixel  
FIG. 9b



1	1	1
1	1	1
1	1	1

A

.2	.44	.2
.44	1	.44
.2	.44	.2

B

FIG. 9f

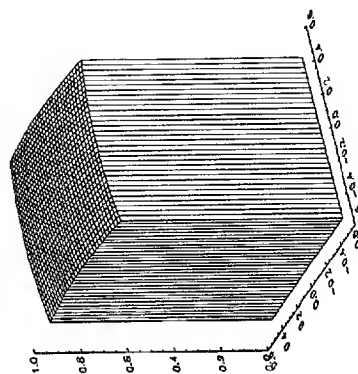


FIG. 9c

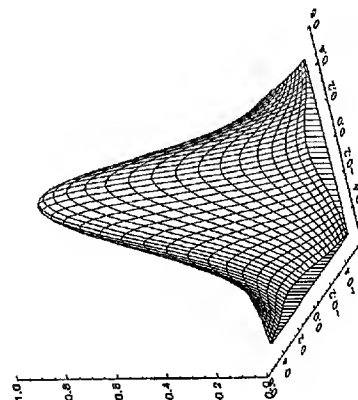


FIG. 9d

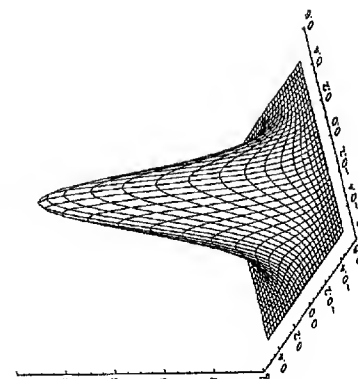
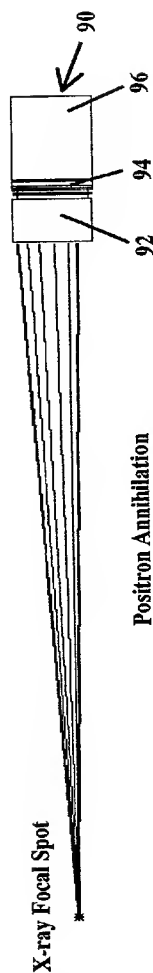


FIG. 9e

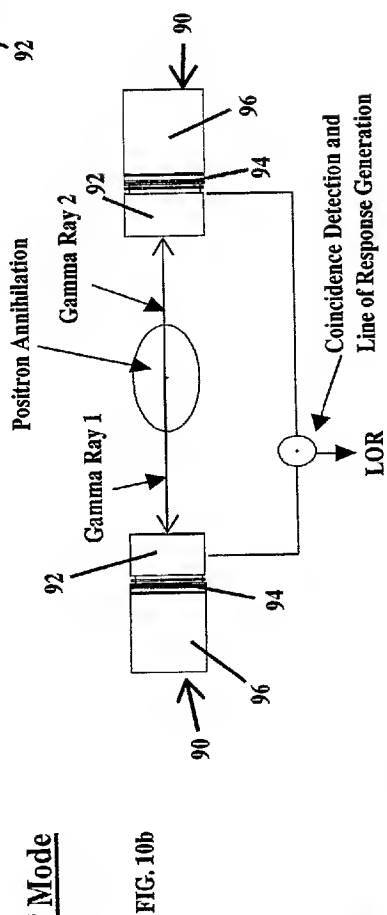
Figure 9

# Multi-Modality XGA Detector Module

## X-Ray Mode



## PET Mode



## NM/SPECT Mode

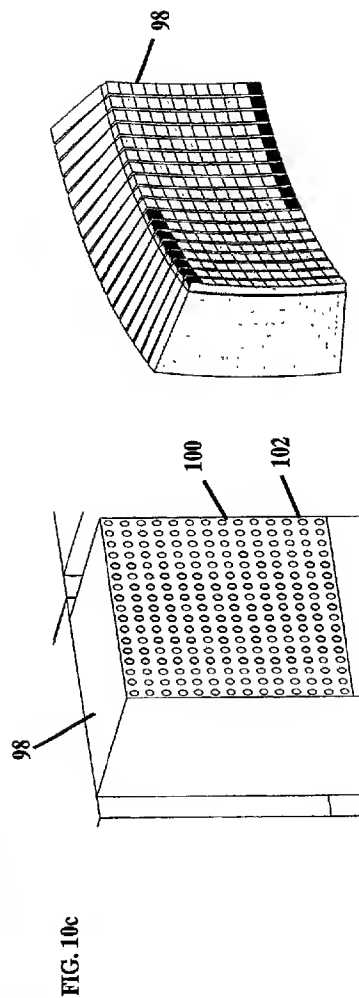


Figure 10

# Detector Module Multi-Modality Collimation

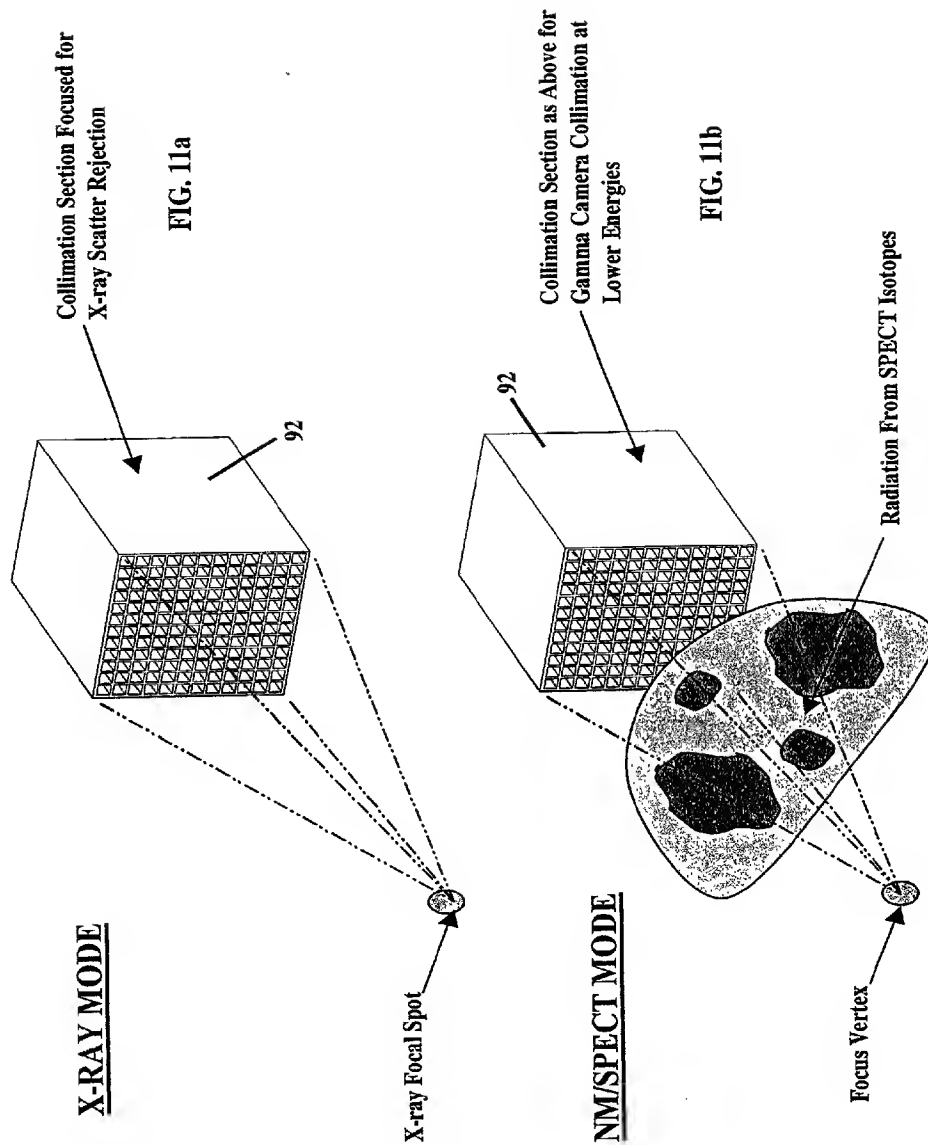


Figure 11

# XGA Detector Module Signal Processing

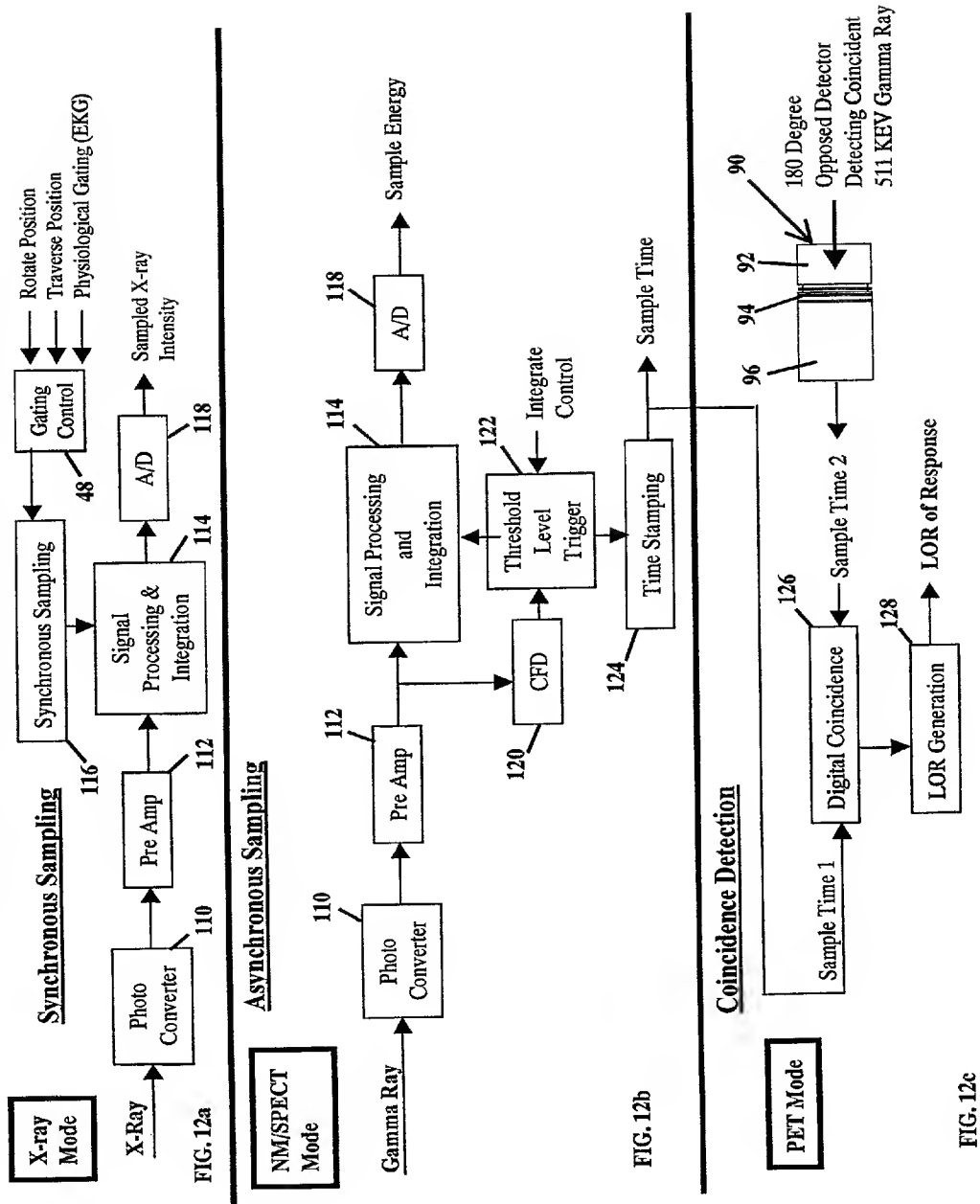


Figure 12

System with Optional PET Anti-Scatter Baffle

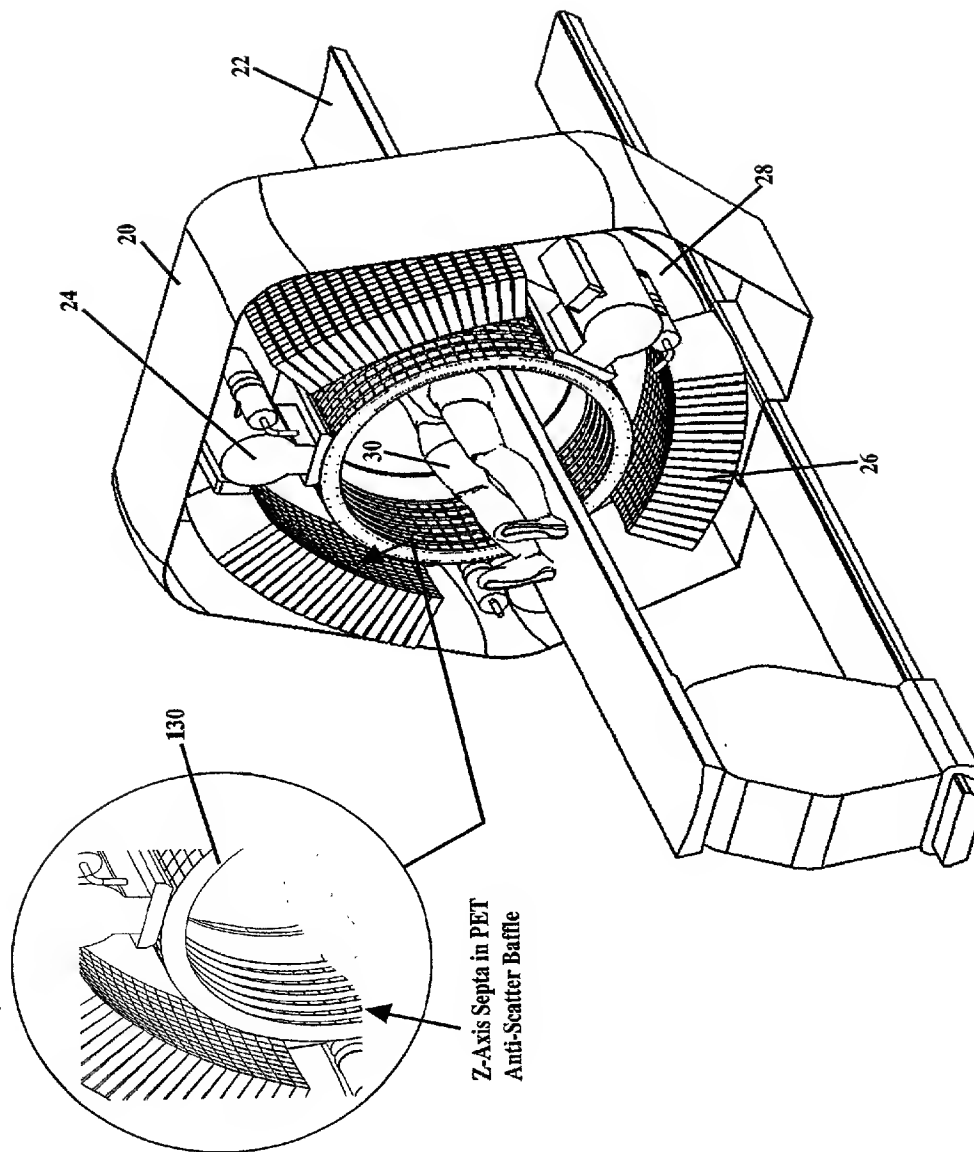


Figure 13

# PET - Anti-Scatter Baffle SEPTA

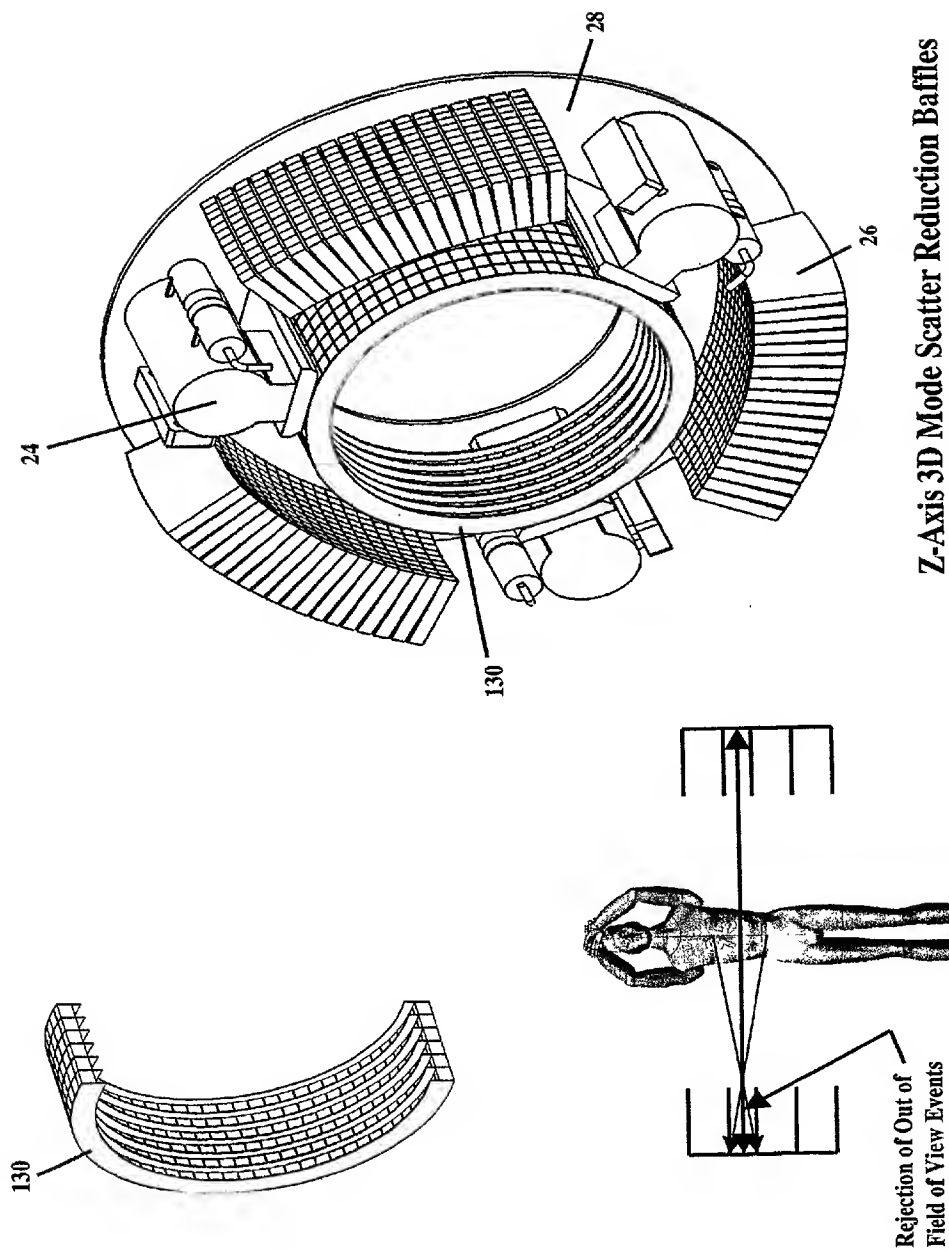
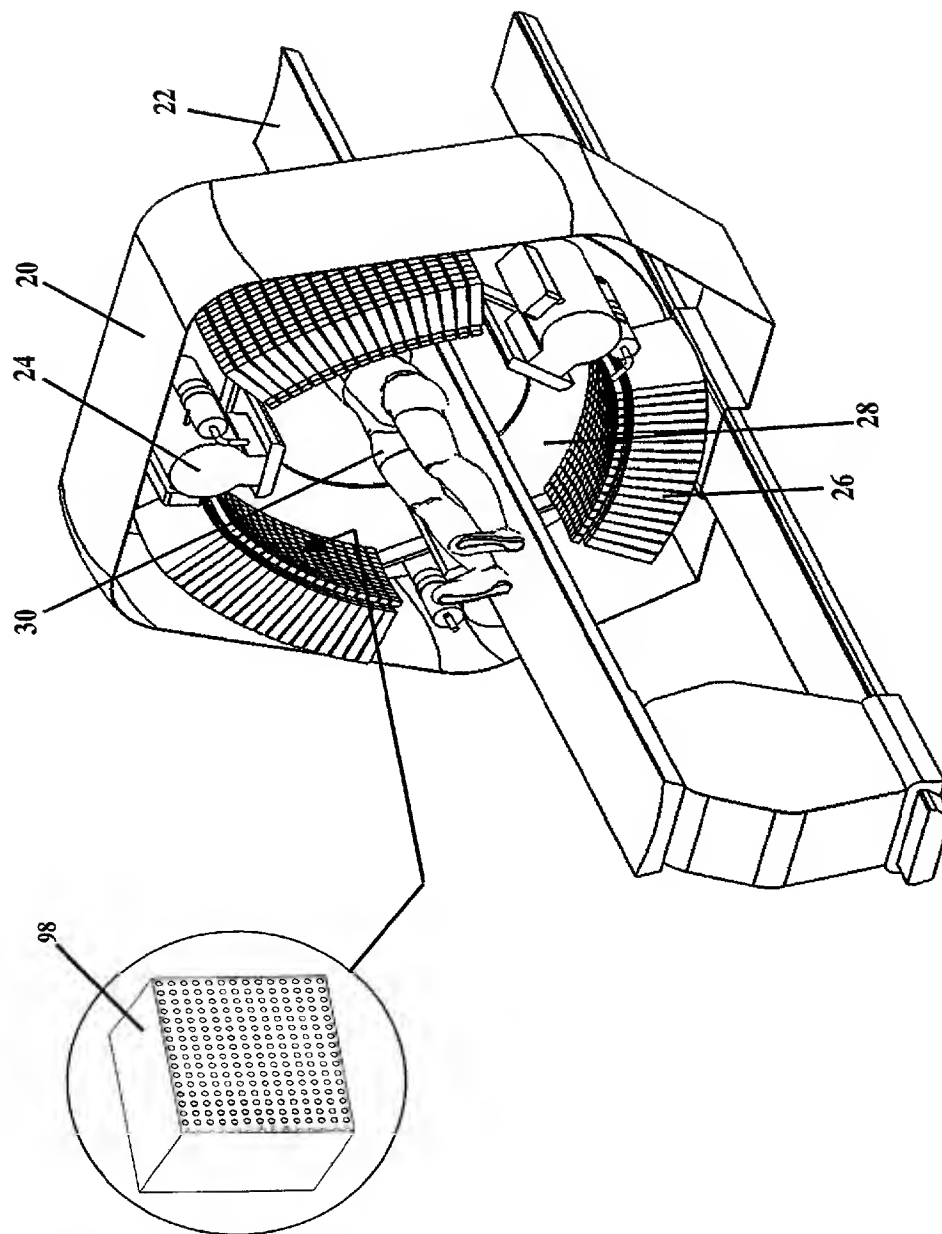


Figure 14

**System With Cone Beam Focused NM/SPECT Collimation**



**Figure 15**

# NM/SPECT Mode with Collimation Ring

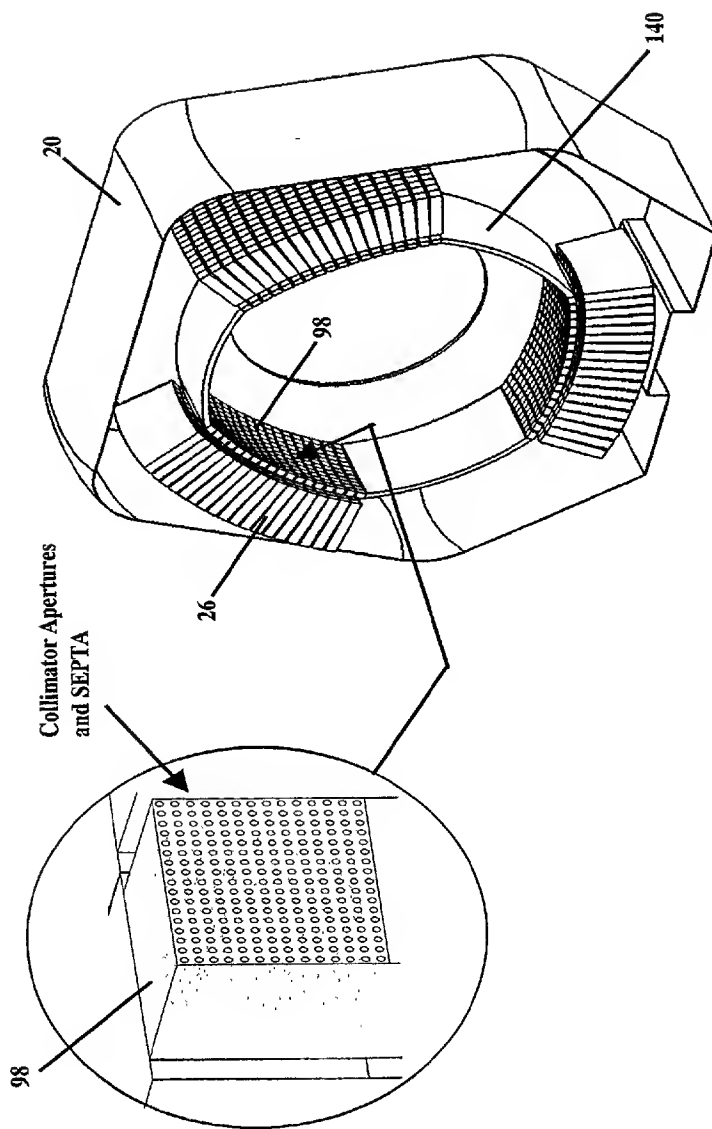


Figure 16



# Cone Beam NM/SPECT LEHR Collimation and Focused 2D Curved

## Detector Array

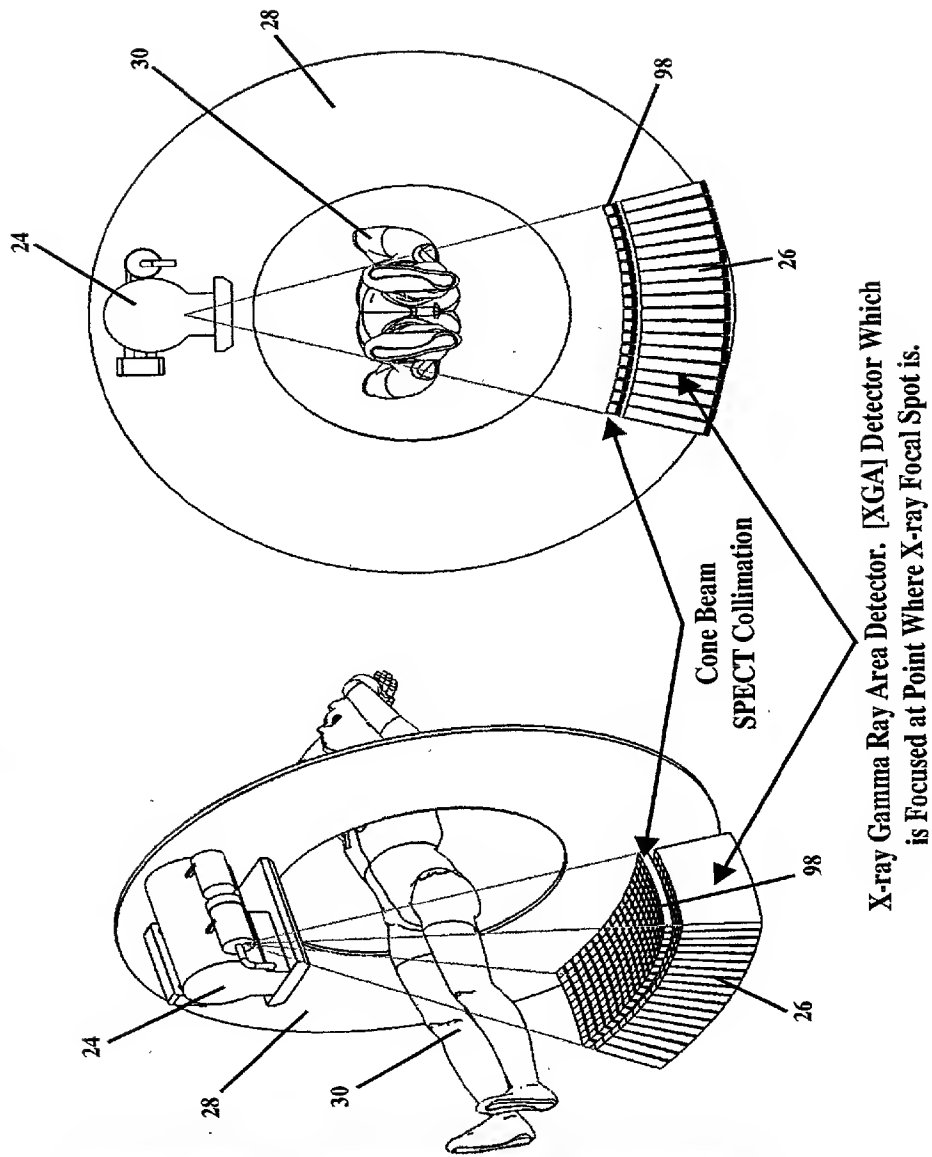
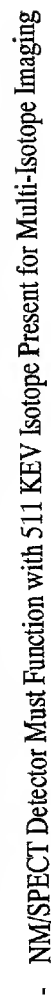


Figure 17

[illegible]

**Figure 18**

Scatter Rejection of 2D Focused Curved Detector Collimation

Rejection of Scatter Signal

Scatter Signal

Direct Signal

Also used for NM Gamma and SPECT Collimation

Acceptance Angle ( $\alpha = \tan^{-1}(D/L)$ )

**Figure 19**

# Sequencing of X-ray Sources for Adaptive Scatter Correction

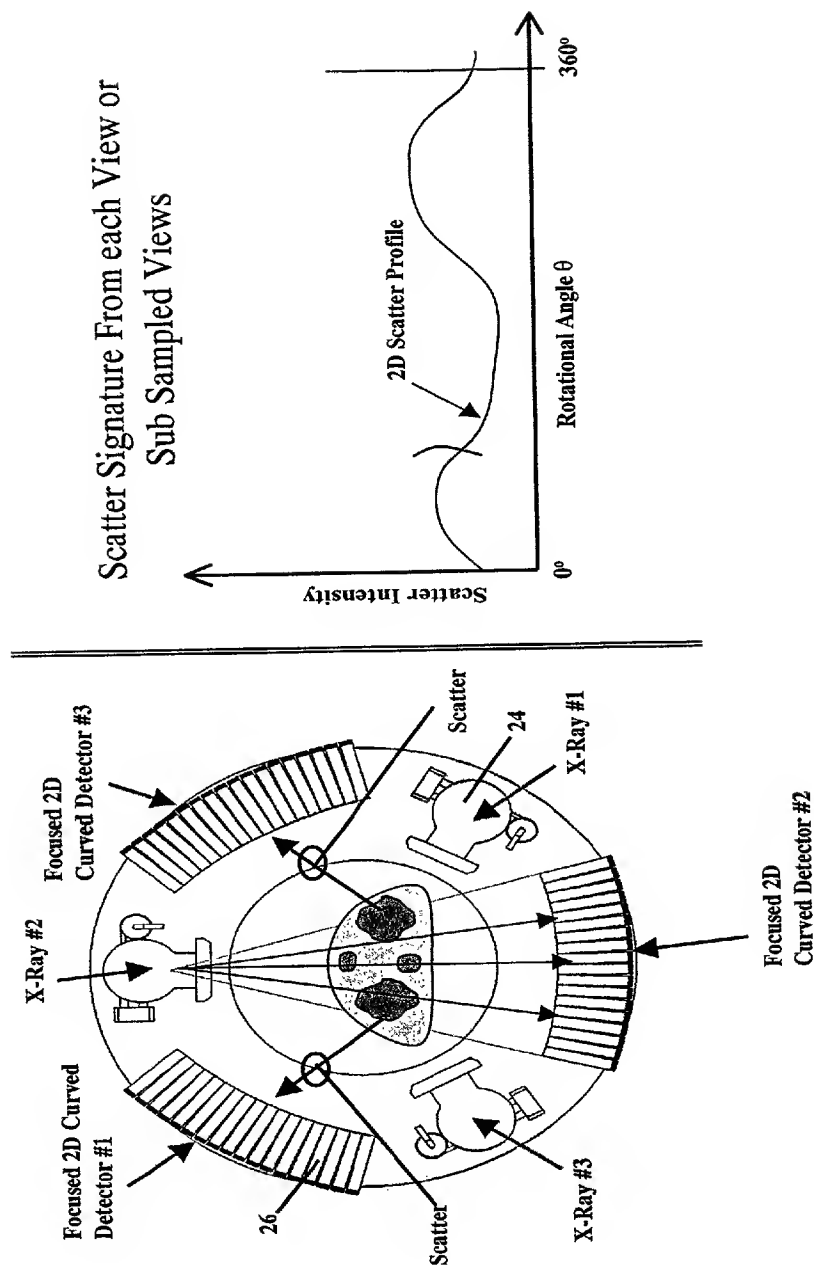


Figure 20



# System Level Diagram of Modulation and Demodulation For Multiple Sources for VCT

## Sources for VCT

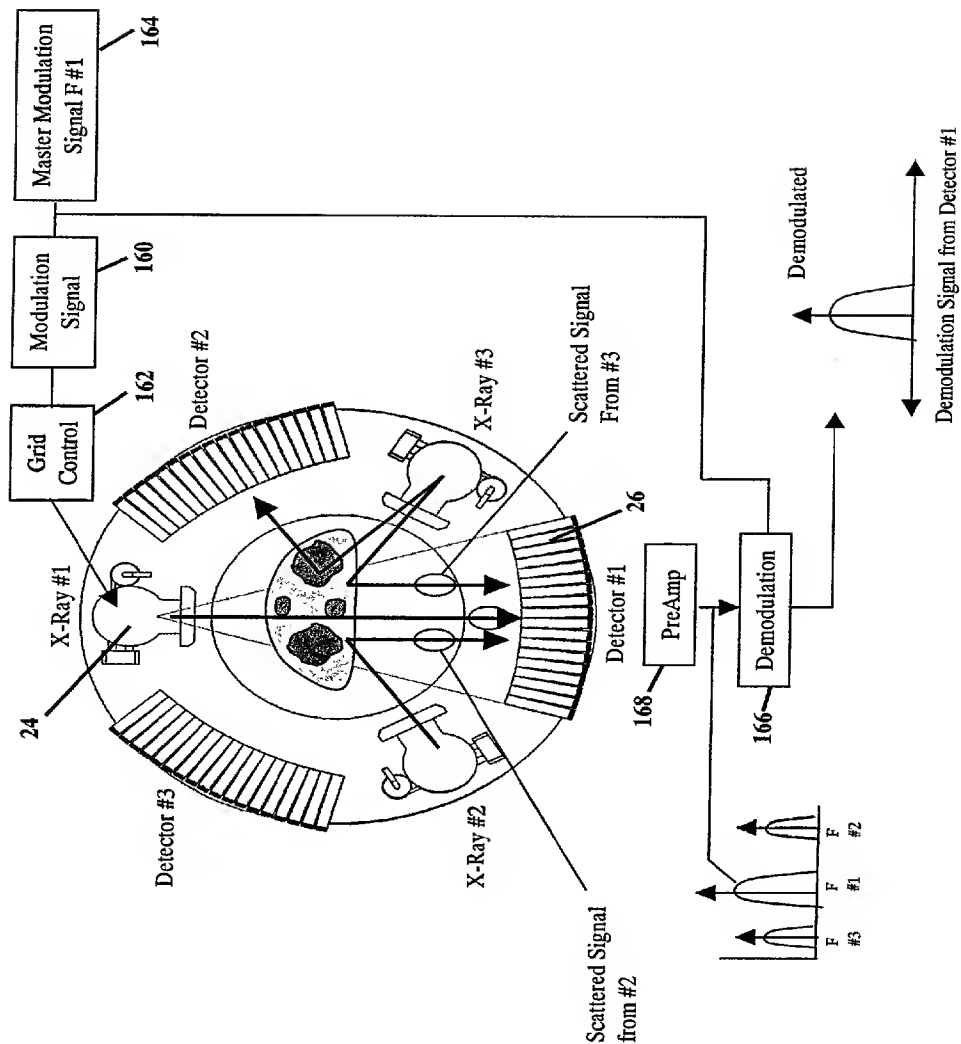


Figure 22

# Step and Shoot VCT Imaging

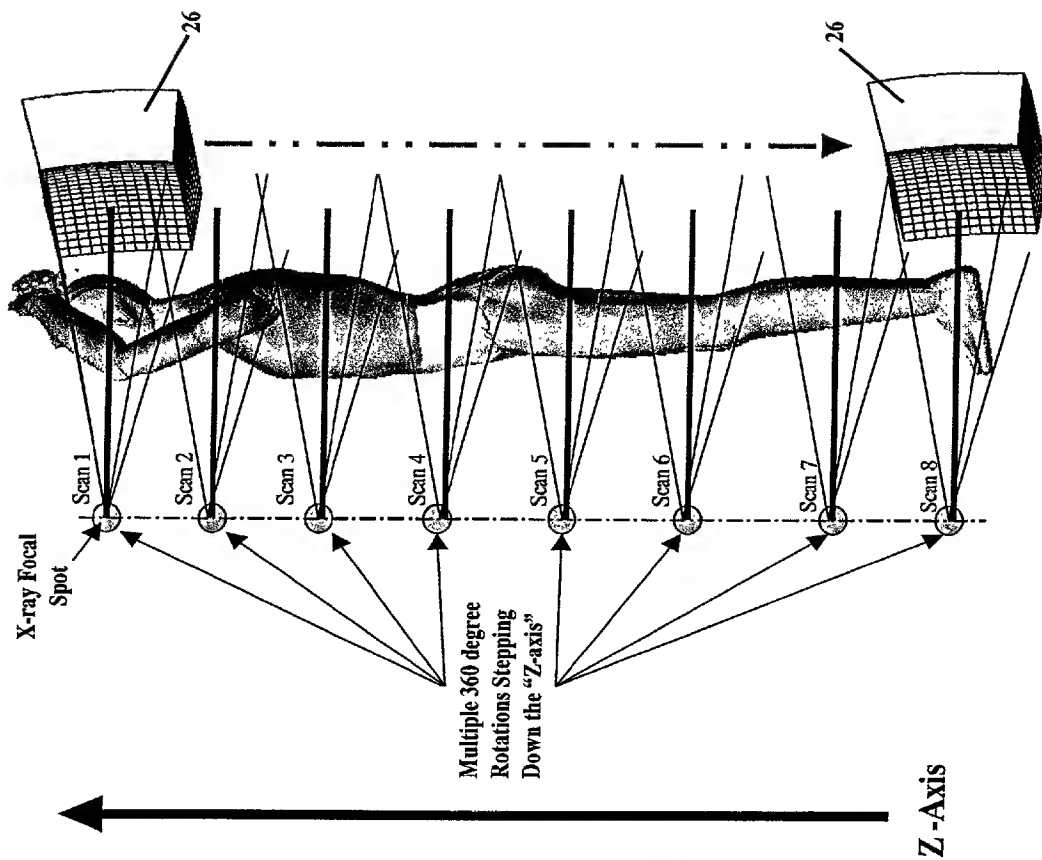
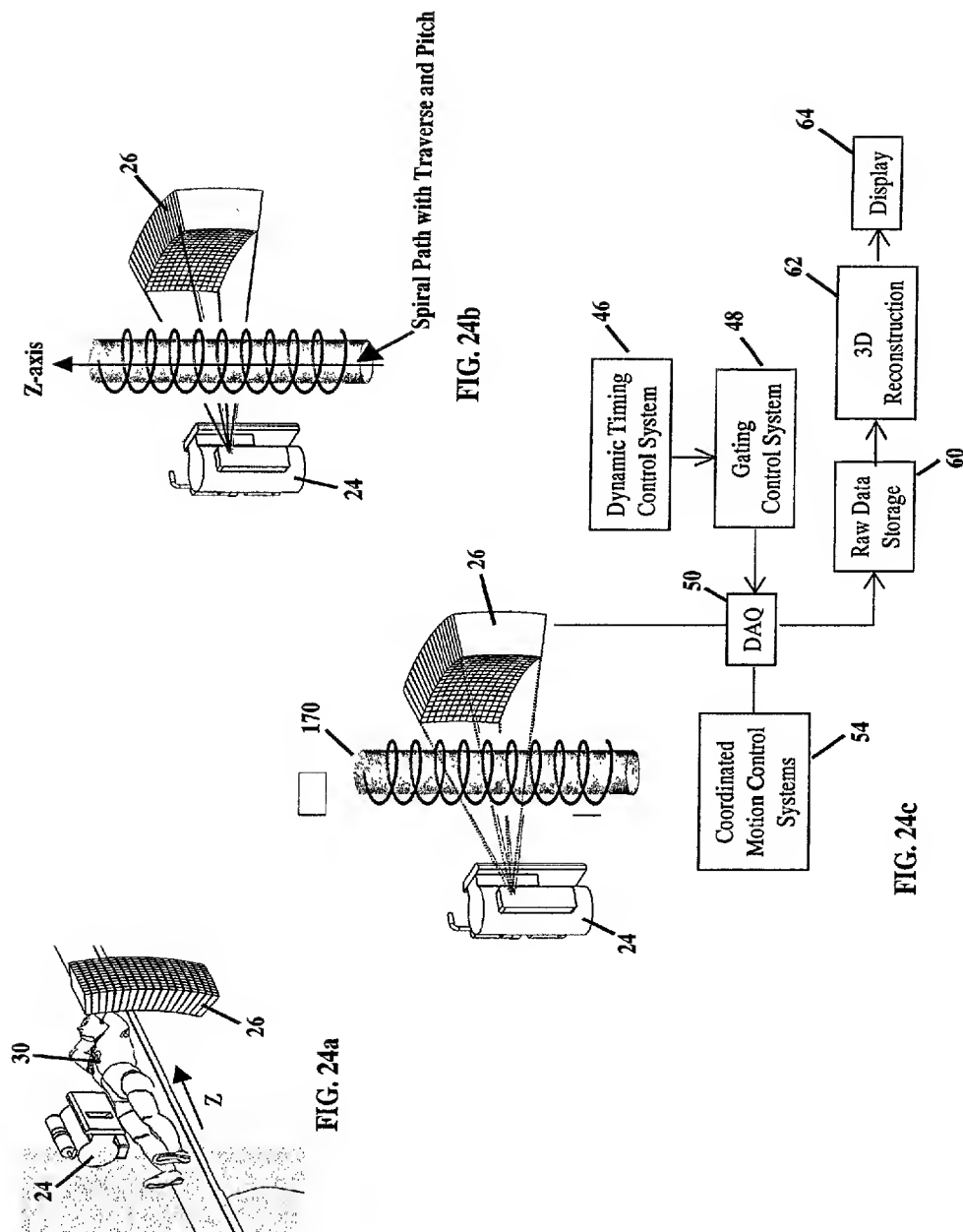


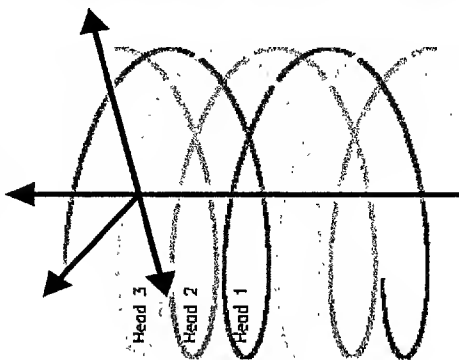
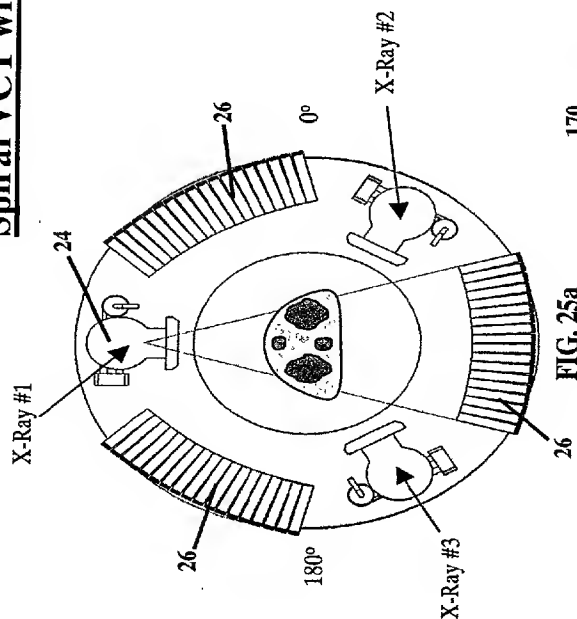
Figure 23

# Spiral 3D X-Ray, DAQ and VCT for Cone Beam Reconstruction





# Spiral VCT with Multiple Heads



Spiral Path with 3 Heads with  
respective Central Rays on  
Reconstruction Cylinder

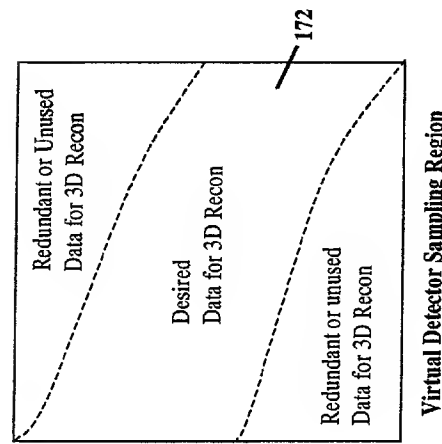
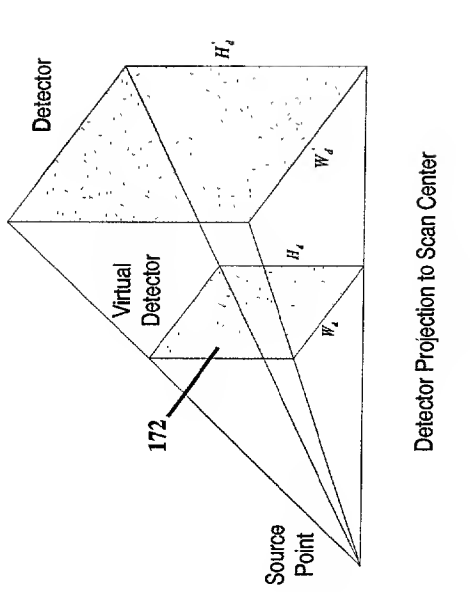
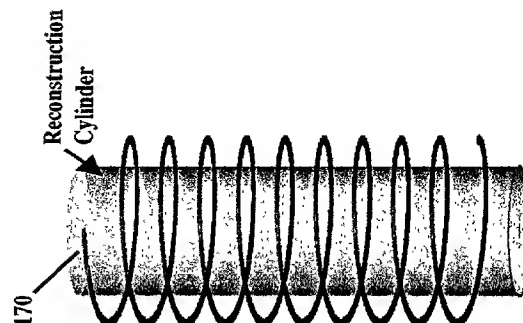


FIG. 25f

Figure 25

# Cone Beam Slant Source Collimation for Spiral VCT Imaging

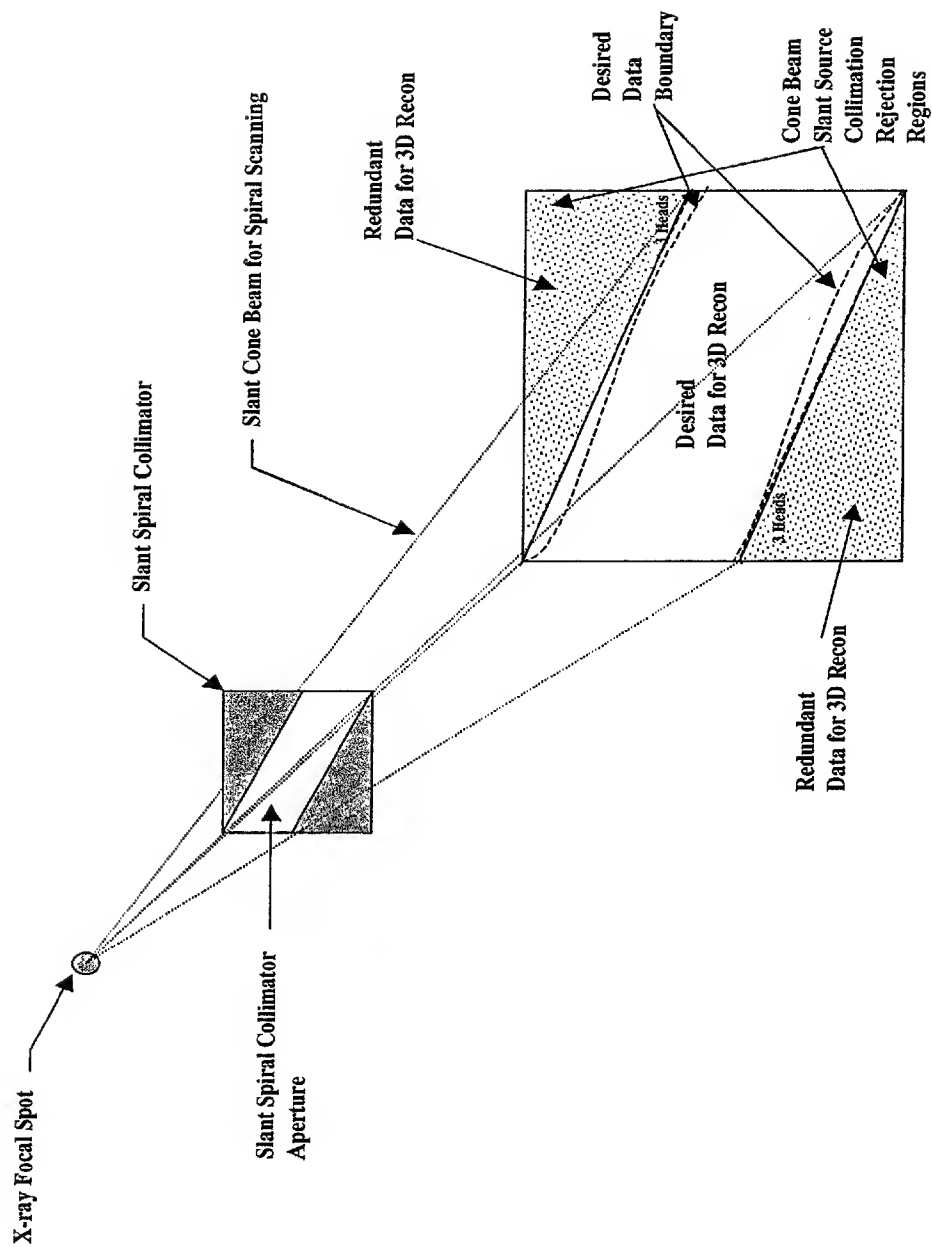


Figure 26

# Multi-Plane Planning System Imaging

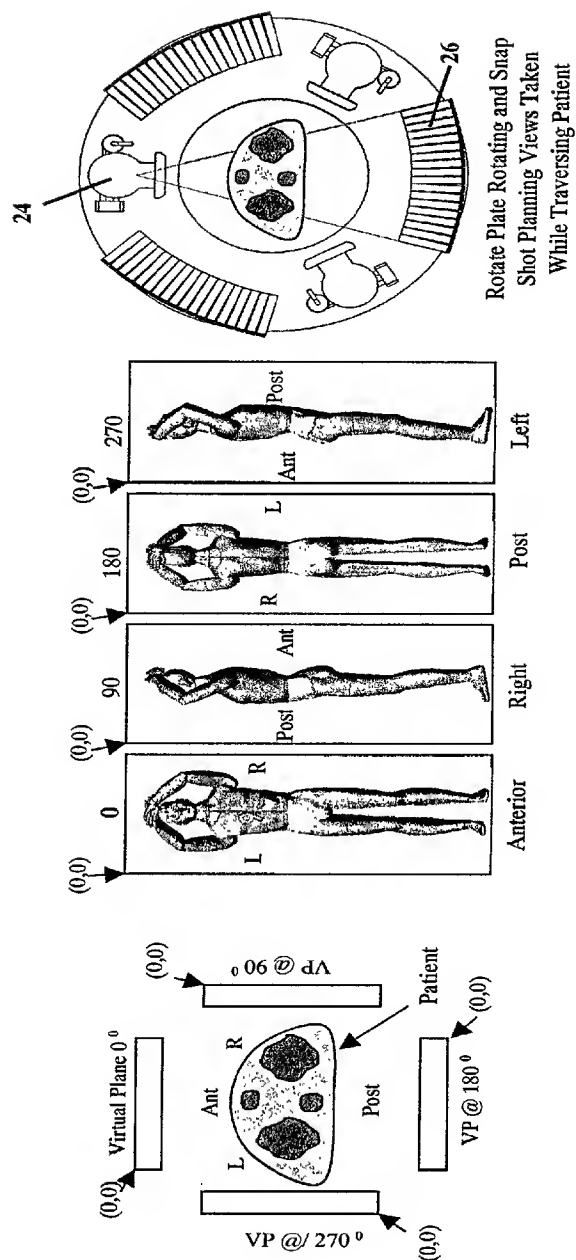


Figure 27

# Whole Body Dose Control From Planning System

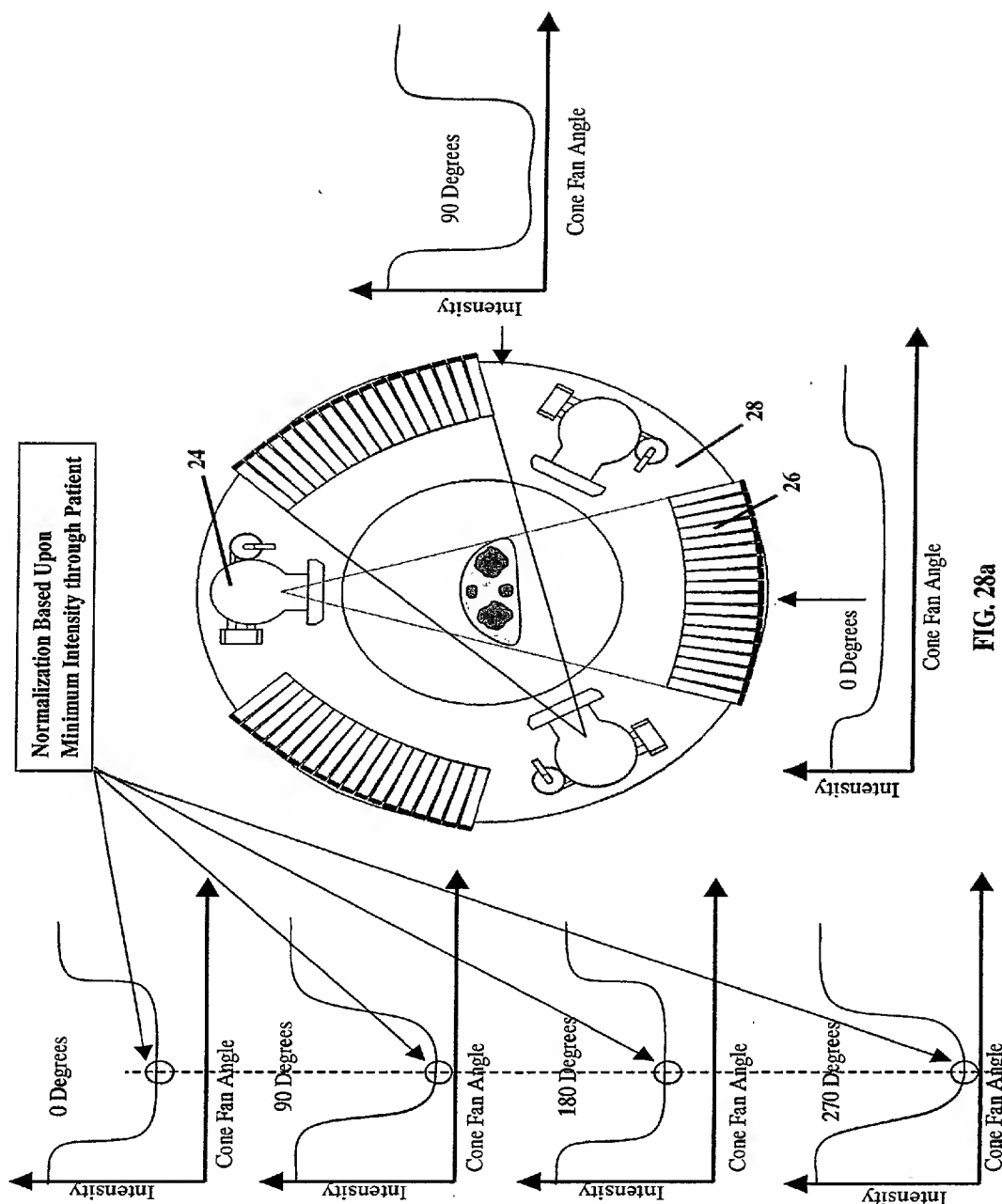
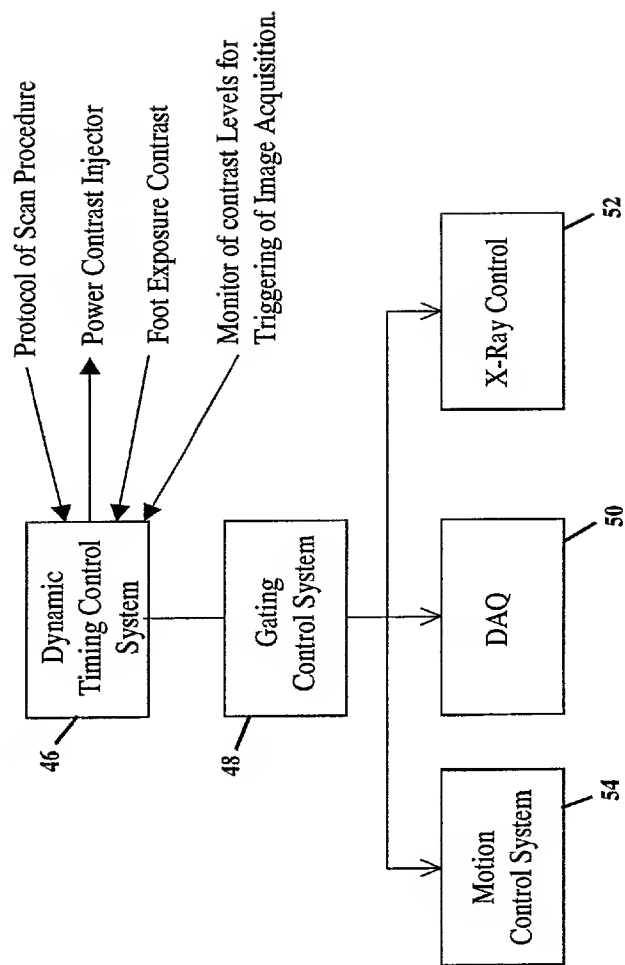


FIG. 28a

Figure 28

FIG. 28b

## Dynamic Timing Control



**Figure 29**

# Retrospective Gated Imaging System

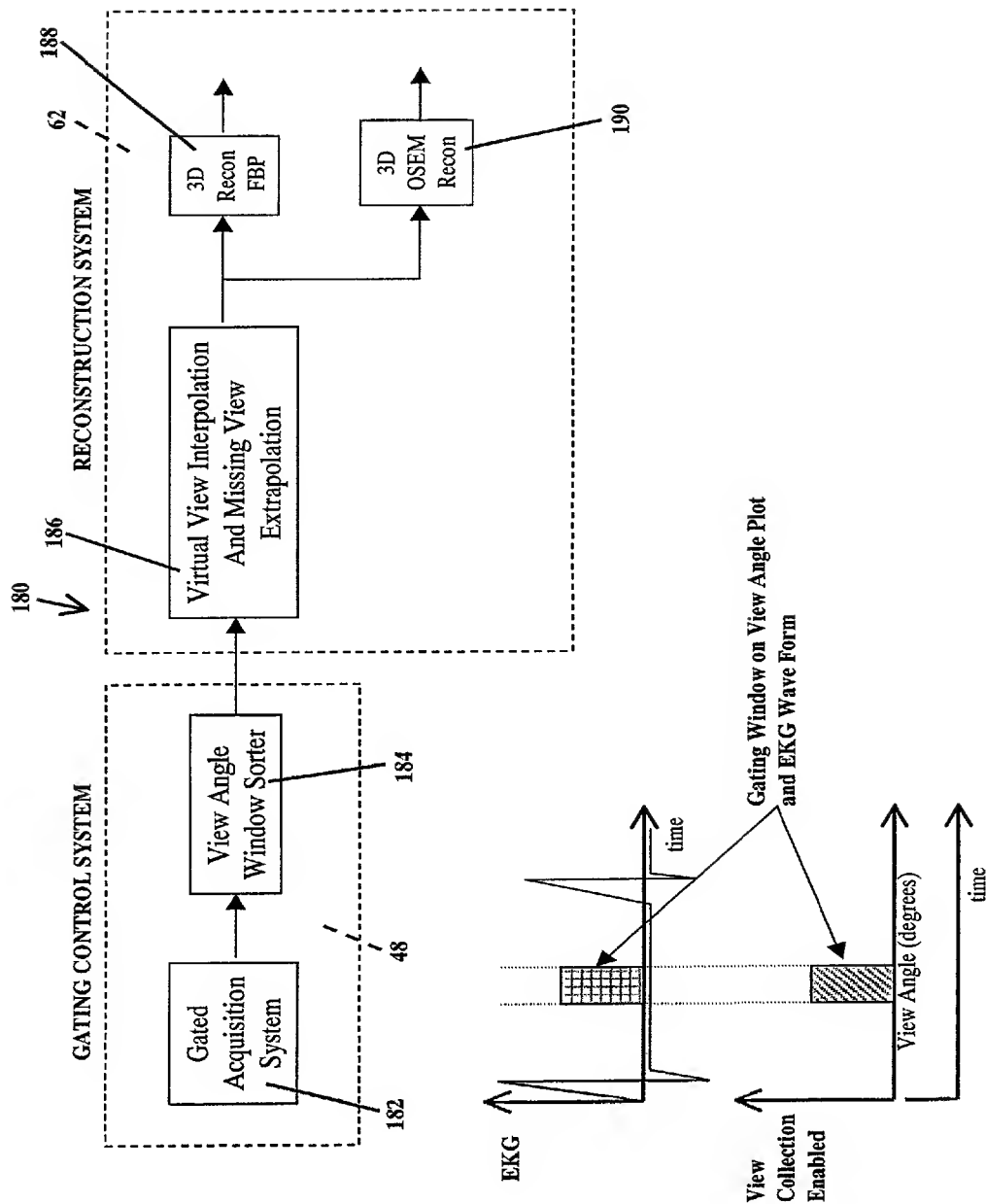


Figure 30

# Prospective Gating Control System with Cardiac EKG

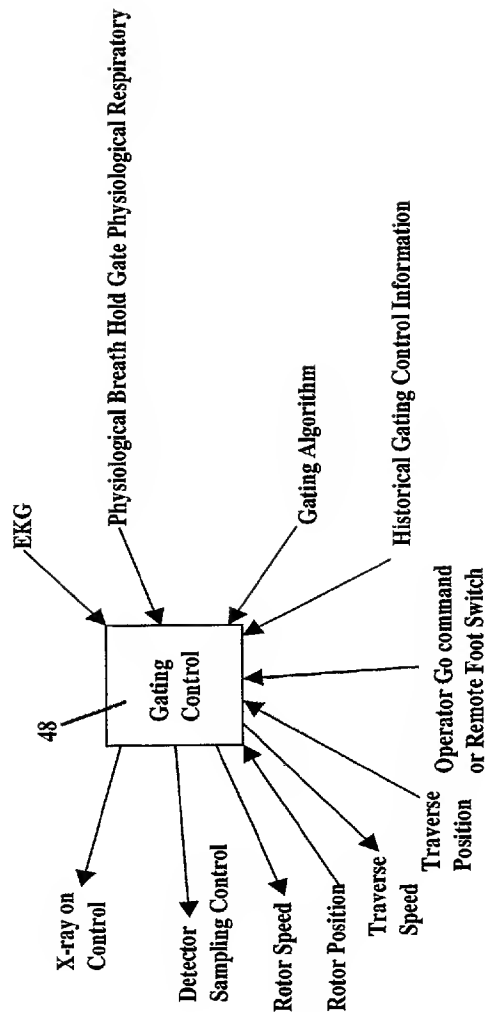
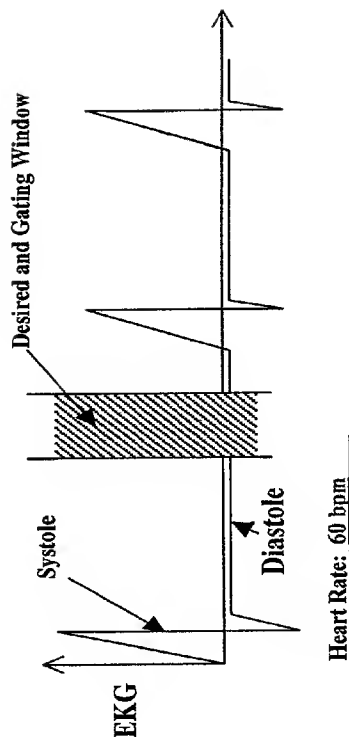


Figure 31

# Prospective and Retrospective Gated DAQ and Reconstruction Imaging

## Prospective Gating Control

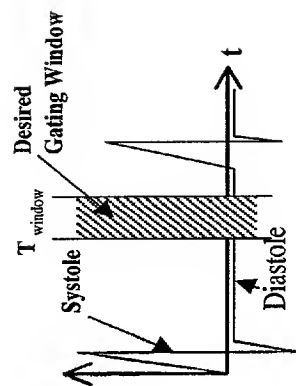
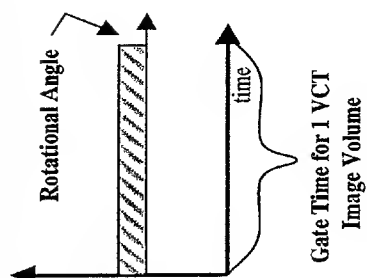


FIG. 32b

## Retrospective Gating Control

FIG. 32a

## Multi Cycle - Contiguous

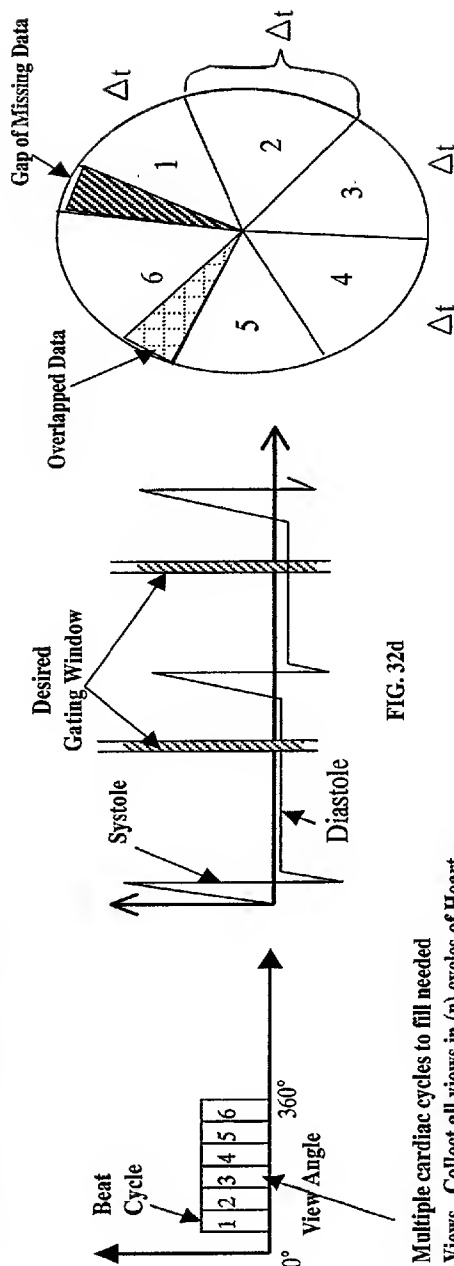
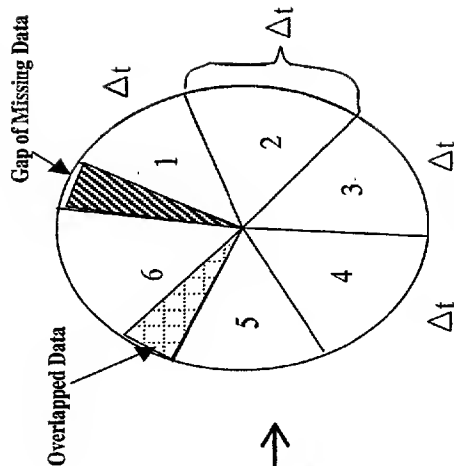


FIG. 32c

Figure 32





# Gated DAQ and Reconstruction for Retrospective Cine' Dynamic Cardiac Imaging

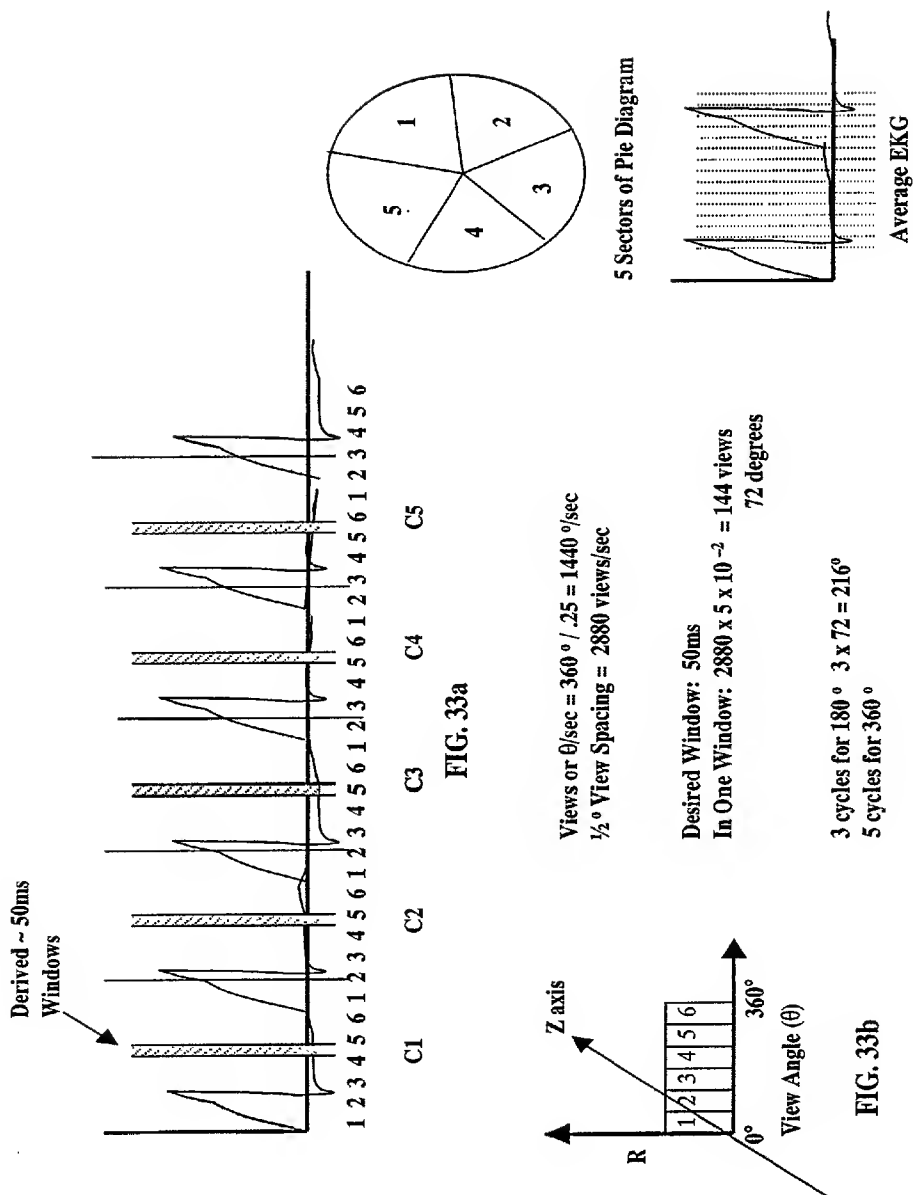
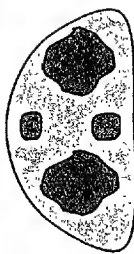


Figure 33

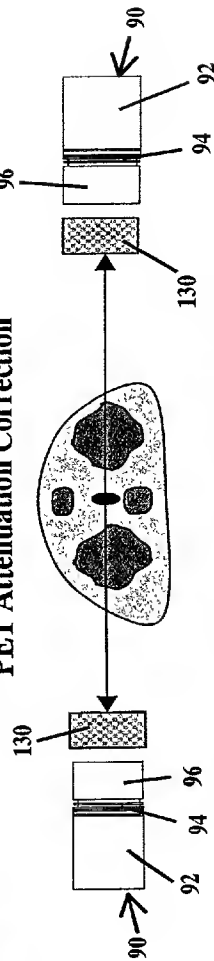
# PET Transmission, Attenuation & Scatter Correction

## VCT Attenuation MAP



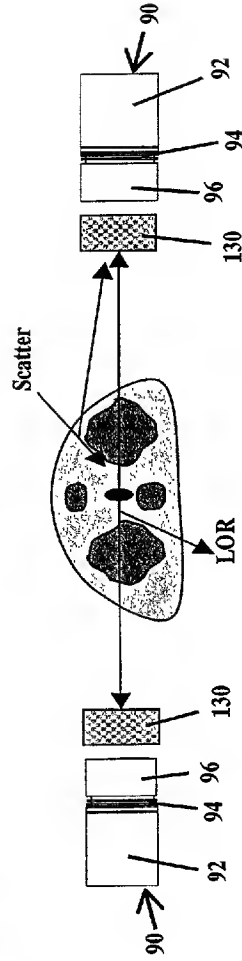
Transmission Attenuation  
Map at 511 KEV Energy Level from VCT Images

## PET Attenuation Correction



Correction Map for PET New Corrected PET  
Projections for OSEM Recon.

## PET Scatter Correction

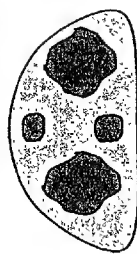


Scatter Correction from VCT Images and  
Count Rates on a Projection View Basis

**Figure 34**

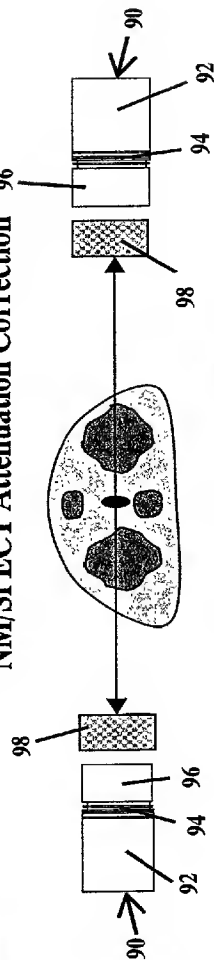
# NM/SPECT Transmission, Attenuation & Scatter Correction

## VCT Attenuation MAP



Transmission Attenuation  
Map at NM/SPECT Energy Levels from VCT Images

### NM/SPECT Attenuation Correction



Correction Map for NM/SPECT New Corrected  
SPECT Projections for OSEM Recon.

### Scatter Correction

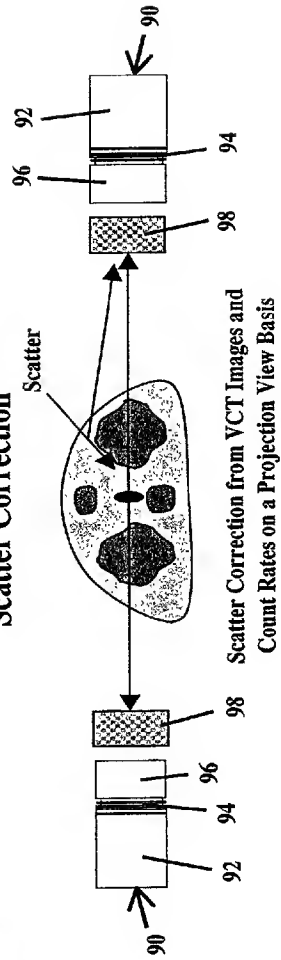


Figure 35

# Patient Fused Multi-Modality Imaging and Analysis System

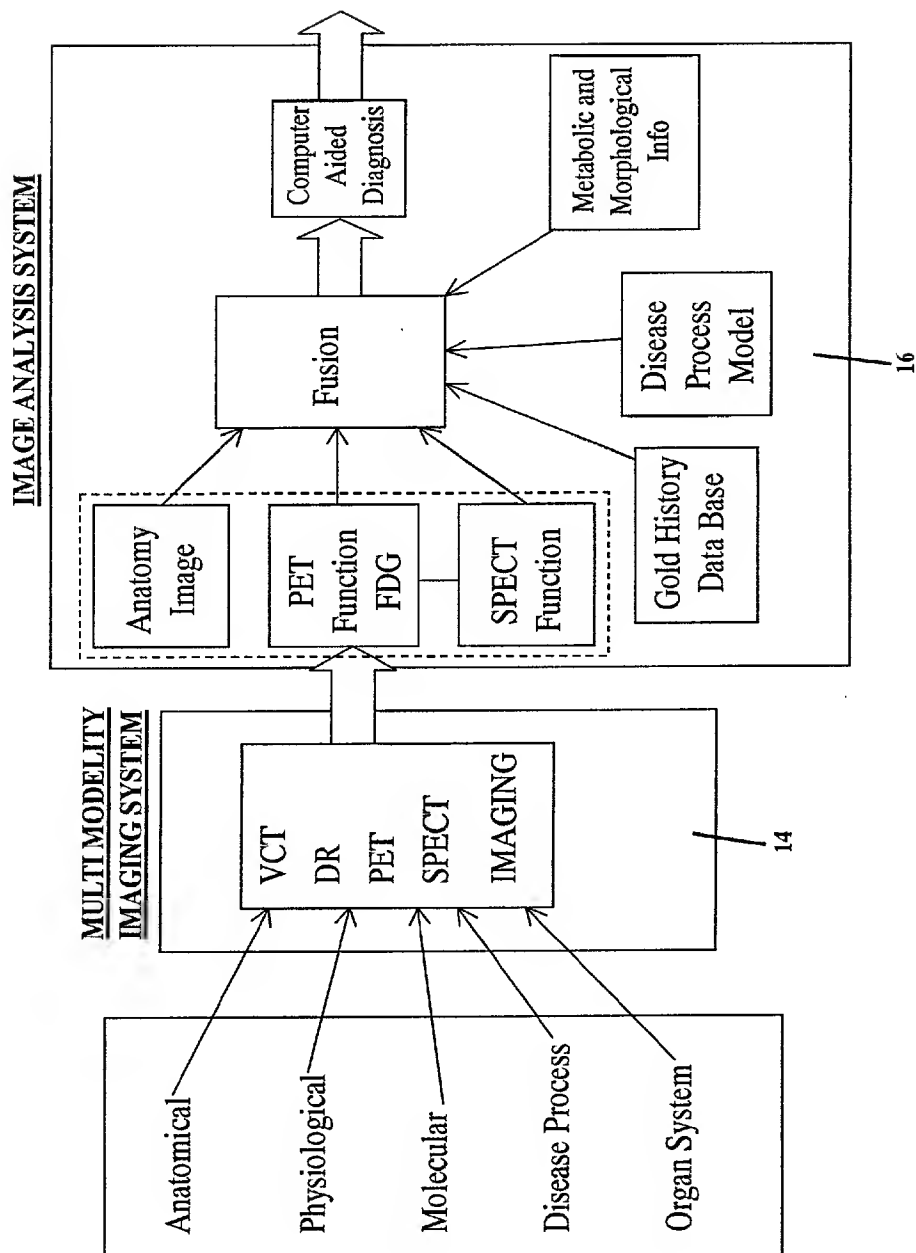


Figure 36

## Interventional Image Control System

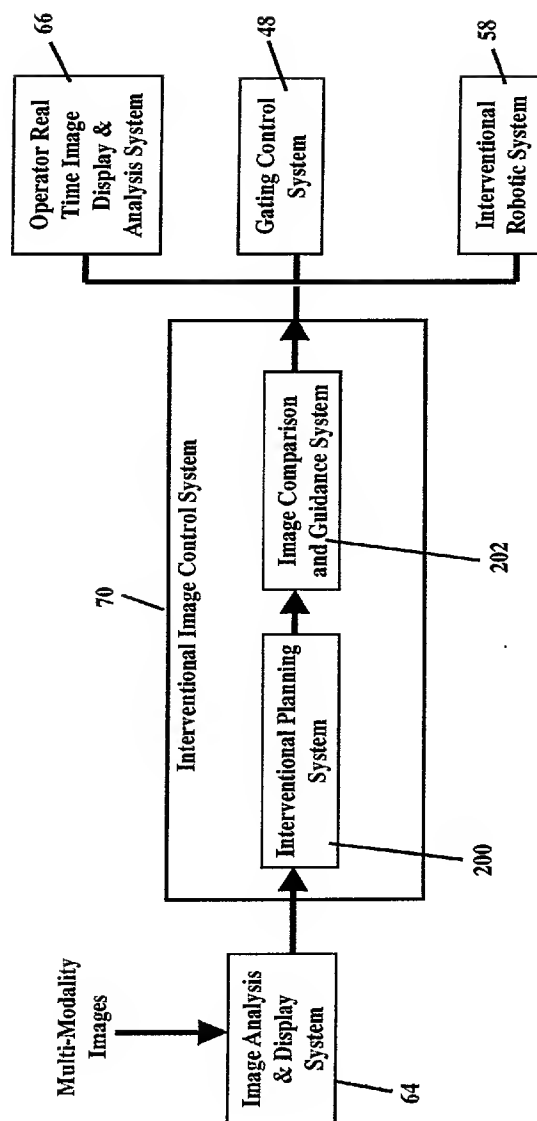
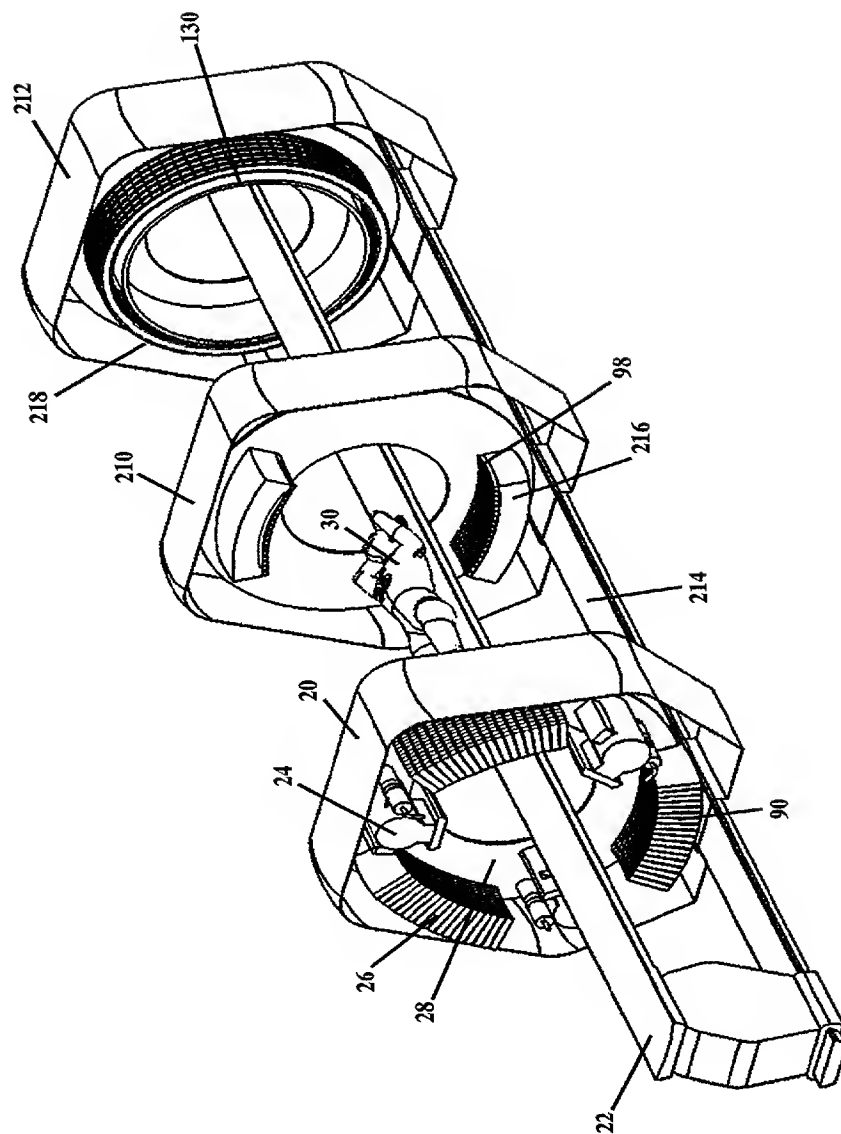


Figure 37

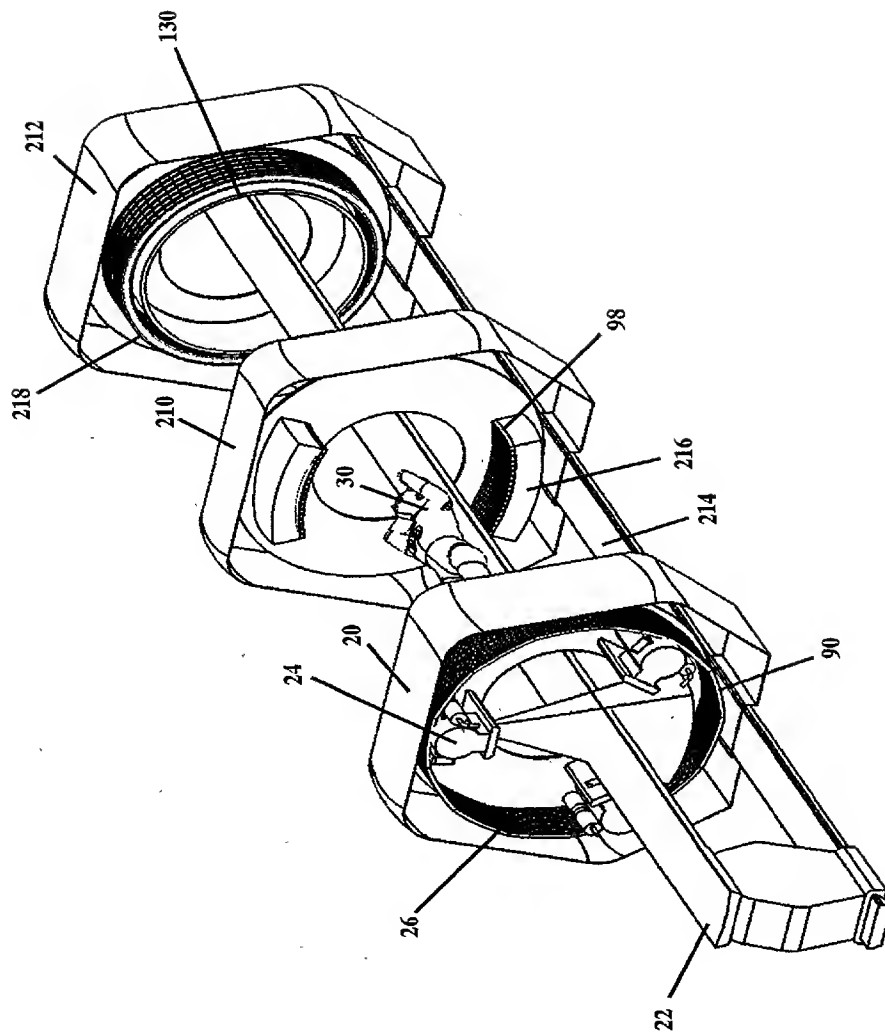
**Multi-Modality Imaging with Independent X-Ray VCT, PET, and  
NM/SPECT Image Acquisition System**



**Figure 38**



**Multi-Modality Imaging with Independent X-Ray 4<sup>th</sup> Generation VCT,  
PET, and NM/SPECT Image Acquisition System**



**Figure 40**



Multi-Modality Imaging System with Stationary  
Focused 2D Curved Detector for VCT, PET and NM/SPECT Imaging

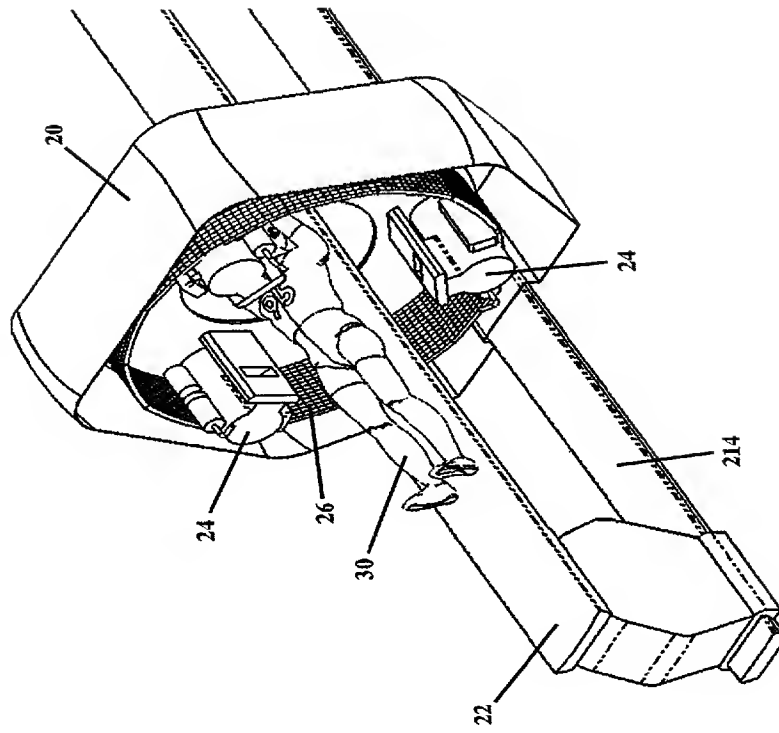
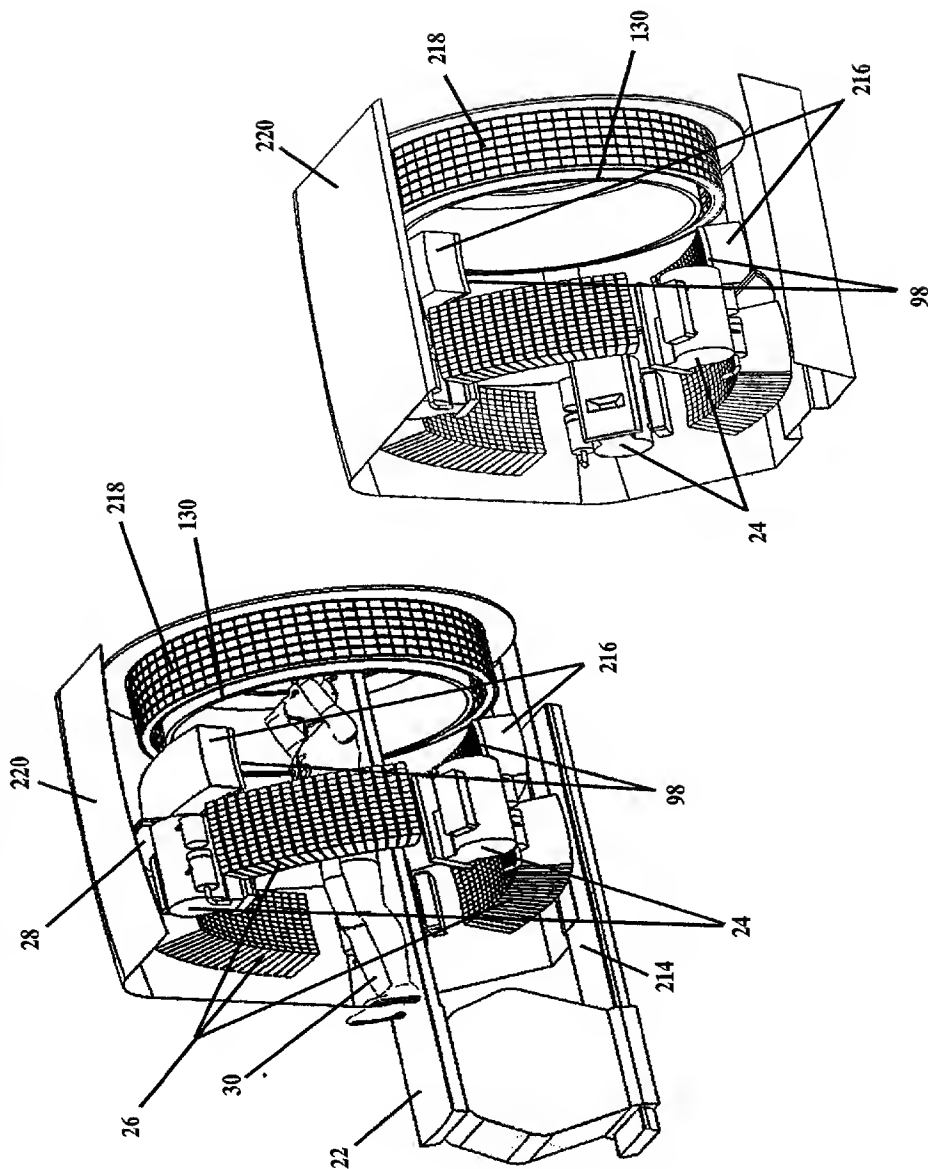


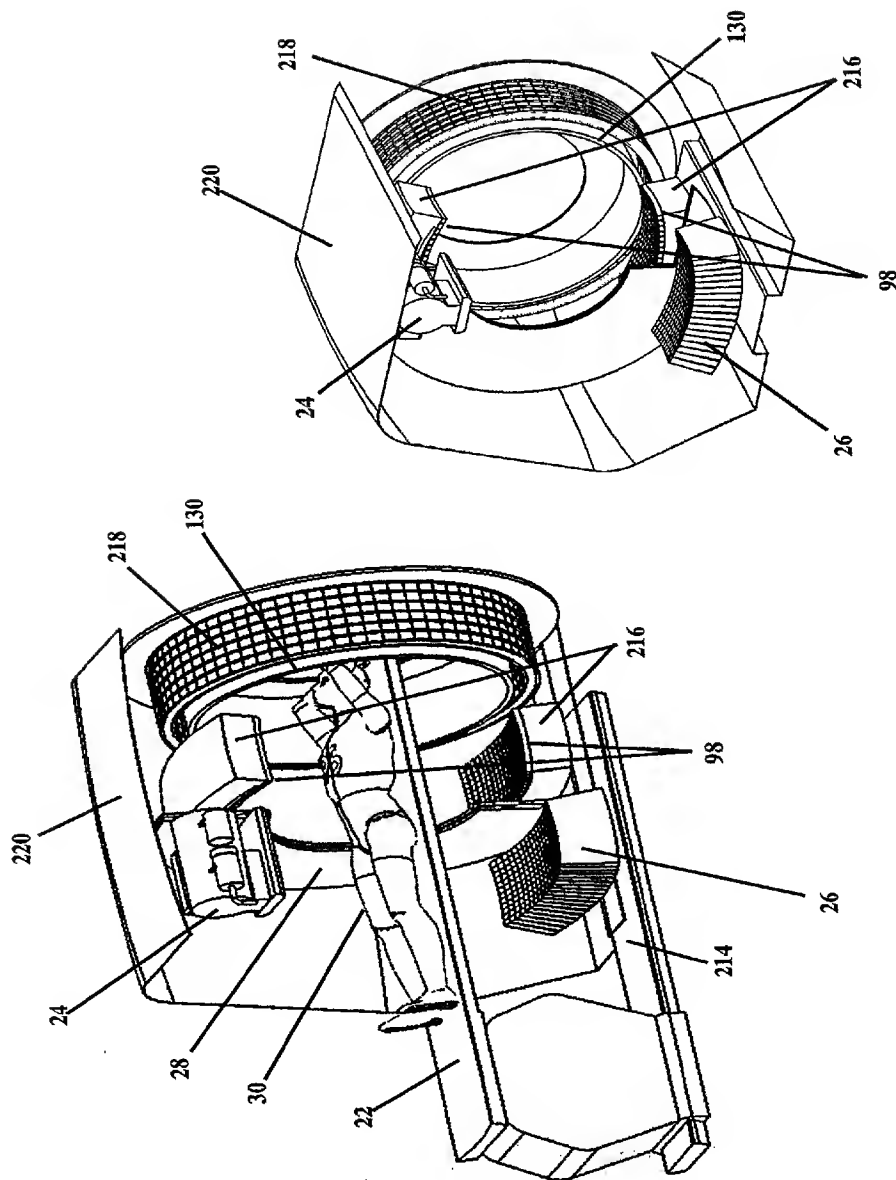
Figure 41

**Multi-Modality Imaging with Common Gantry and Independent X-Ray VCT,  
PET, and NM/SPECT Image Acquisition System**



**Figure 42**

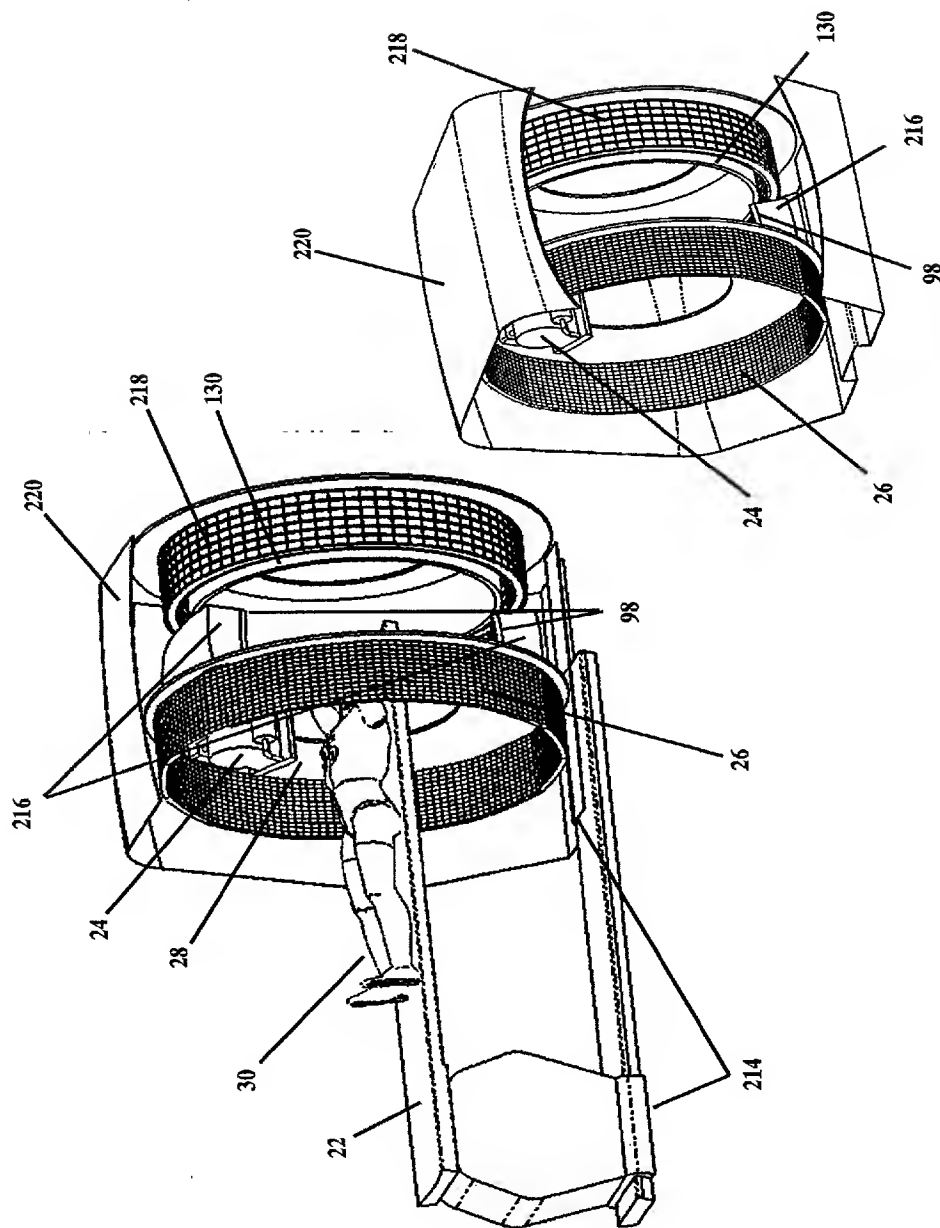
**Multi-Modality Imaging with Common Gantry and Independent X-Ray  
Single Head VCT, PET, and NM/SPECT Image Acquisition System**



**Figure 43**



**Multi-Modality Imaging with Common Gantry and Independent Single X-Ray 4<sup>th</sup> Generation VCT, PET, and NM/SPECT Image Acquisition System**



**Figure 45**